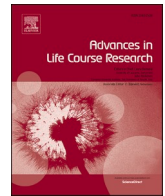




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Positive and negative risk-taking: Age patterns and relations to domain-specific risk-taking[☆]

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ABSTRACT

People take risks at all ages to achieve certain goals. Although these goals may be achieved through negative risks (e.g., adolescent drinking to impress their friends), people also take positive risks. Positive risks are theorized to help individuals achieve goals in developmentally appropriate and socially acceptable ways, such as initiating a new friendship as an adolescent, applying for a promotion as a young adult, or exploring a new hobby as a retiree. To test the hypothesis that people endorse different patterns of risk-taking across life, we examined age patterns in positive and negative risk-taking with a sample of individuals ranging in age from 12 to 71 years. In adults aged 19–71, we also examined to what extent positive and negative risk-taking are associated with domain-specific risk-taking and risk-taking propensity. Results indicated that positive risk-taking varied with age in the form of an inverted-U shape and peaked in middle adulthood. Negative antisocial risk-taking varied with age in the form of a U shape and was highest in adolescence. Negative health risk-taking varied with age in the form of an inverted-U shape and peaked in middle adulthood. In adults, greater positive risk-taking was associated with greater risk-taking in the social domain and greater risk-taking propensity. Greater negative risk-taking was associated with greater risk-taking in ethical and health/safety domains, and with greater risk-taking propensity. Altogether, this study is the first to demonstrate age patterns in positive and negative risk-taking across adolescence and adulthood. It also contributes to the validity of positive risk-taking as a construct distinct from negative risk-taking.

1. Introduction

Broadly speaking, risk-taking can be defined as engaging in any behavior with a wide range of possible outcomes, either good or bad (Figner & Weber, 2011). Although risk-taking is commonly seen as an issue during adolescence (Defoe et al., 2015; Duell et al., 2018; Van Duijvenvoorde et al., 2016; Willoughby et al., 2021), we know it persists into adulthood (Bonem et al., 2015; Josef et al., 2016; Mata et al., 2011, 2015; Mamerow et al., 2016; Rolison et al., 2013). For decades, researchers and public health specialists have been concerned about risk behavior during adolescence given the vast public health implications of adolescents' risk-taking such as reckless driving, substance use, and unprotected sex. Equally important, however, is the fact that (1)

risk-taking behavior continues into adulthood and (2) not all risks are inherently dangerous or maladaptive. Indeed, people take risks at all ages to achieve certain goals. Although these goals may be achieved through *negative* risks (e.g., adolescent drinking to impress their friends), people also take *positive* risks. Positive risks are theorized to help individuals achieve goals in developmentally appropriate and socially acceptable ways (Duell & Steinberg, 2021), such as initiating a new friendship as an adolescent, applying for a promotion as a young adult, exploring a new hobby as a retiree, or maintaining independence as an older adult. To test the hypothesis that people endorse different patterns of risk-taking over the life course, we examine age patterns in positive (e.g., initiating friendships) and negative risk-taking (e.g., substance use) with a sample of individuals ranging in age from 12 to 71 years. In

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adults aged 19–71, we also examine to what extent positive and negative risk-taking are associated with risk-taking in different life domains (ethical, financial, health/safety, social and recreational) and risk-taking propensity. Altogether, this study is the first to demonstrate age patterns in positive and negative risk-taking across adolescence and adulthood.

1.1. Positive and negative risk-taking

Risk-taking is commonly thought of as engaging in inherently harmful behaviors that need to be managed and prevented. In contrast, risk-taking is rarely considered an opportunity to promote positive development and well-being. In the developmental literature, researchers have distinguished different categories of risk behaviors (Chassin et al., 1989; Duell & Steinberg, 2019, 2021; Fischer & Smith, 2004; Gullone et al., 2000; Hansen & Breivik, 2001; Wood et al., 2013). For example, Chassin et al. (1989) have distinguished between “constructive” and “destructive” deviance, referring to unconventional behaviors that have a positive function (e.g. being adventurous, independent, outspoken) and behaviors that can lead to detrimental personal or social outcomes, respectively. Similarly, Fischer and Smith (2004) have distinguished between maladaptive and adaptive risks, which are defined by their potential to lead to negative life outcomes (where adaptive risks are not likely to lead to negative life outcomes). Inspired by this literature, Duell and Steinberg (2019, 2021) proposed a framework that organizes risk behaviors along a spectrum of desirability. According to the authors, at one end of the spectrum are *positive* risks that are beneficial to an individual’s development and socially acceptable, such as asking someone new on a date, running for a leadership position, or standing up for one’s beliefs. At the other end of the spectrum are *negative* risks that are maladaptive to one’s development and typically antisocial, such as using drugs, fighting, or stealing. There are, of course, behaviors falling along the middle of the spectrum that are more ambiguous in terms of social acceptability. For example, protesting for civil rights may result in detention by the police, but these behaviors may also be accepted as leading to positive change. There are certainly also cultural differences in the perception of which risks are positive and which are negative (for a detailed discussion, see Duell & Steinberg, 2021).

Both negative and positive risk-taking have the potential to yield costs and benefits (e.g. by taking positive risks, people may experience negative outcomes such as failure, rejection, or even injury). However, what distinguishes positive from negative risks is that positive risks are considered beneficial to people’s self-growth or well-being and are socially acceptable (Dworkin, 2005; Hansen & Breivik, 2001). In society, positive risks are promoted and negative risks are prevented. For example, adults are likely to offer adolescents opportunities and support for joining a sports team, whereas they are unlikely to offer them opportunities and support for drinking alcohol. Thus, engaging in positive risks allows individuals to achieve their goals in ways that are more likely to strengthen, rather than weaken, their connections to society (Duell & Steinberg, 2019). Furthermore, focusing solely on adolescent negative risk-taking reinforces a deficit-based perspective of adolescent development. Distinguishing between risks that help youth meet developmental milestones in socially acceptable ways versus risks that are antisocial or illegal is important for enhancing adolescents’ potential to be thriving, contributing members of society. Although the terms positive and negative are crude and imperfect categorizations of behavior, they are used in the literature to emphasize the point that not all risks are inherently problematic. Rather than reducing risk behavior altogether, it is important to promote positive risks while minimizing negative ones.

Both developmental and evolutionary theories (Ellis et al., 2012; Mata et al., 2015; Spear, 2000) assume that risk-taking has an adaptive function, such as promoting the transition from childhood to adulthood or increasing the chance of reproductive success. The adaptability of

risk-taking seems to be based, on one hand, on exploration (a willingness to explore an unknown environment), and on the other hand, on learning from experience (verifying which actions were profitable and which were harmful) (Ciranka & van den Bos, 2021; Lloyd et al., 2021). Certainly, many positive and negative risks are opportunities to explore and learn from experience (e.g. taking a challenging course, trying a drug for the first time). However, positive risks are more likely to be an opportunity to gain significant benefits in a socially acceptable way. Some positive risks may be particularly conducive to the acquisition of new skills and relationships, fulfilling passions, and improving well-being at different times of life (Duell & Steinberg, 2019). Further, rather than being a function of individual differences in impulsivity or the desire for immediate gratification (e.g. the pleasure of driving fast), individuals may endorse positive risks in the service of long-term goals (e.g. developing a passion or career) (Duell & Steinberg, 2020, 2021).

1.2. Age patterns in positive and negative risk-taking

While there are both purposes and opportunities to take positive and negative risks throughout life, little is known about how positive risk-taking varies across age, and how that variation relates to age patterns in negative risk-taking. Public health research has consistently identified young adults as being the most likely to take certain negative risks, such as binge drinking, risky driving, or risky sex (Willoughby et al., 2021). However, age patterns in risk behavior differ depending on the type of risk in question and how risk is measured (e.g., some work shows that age patterns in self-reported risk-taking vary from age patterns in risk-taking on experimental tasks; Duell et al., 2018; Mata et al., 2011). For example, in a large study on risk-taking patterns across the world, Duell et al. (2018) divided negative risks into health (e.g. substance use, risky sex) and antisocial risks (e.g. getting into a fight, vandalizing) and showed that 20-year-olds were most likely to take health risks, while antisocial risks were most common in teenagers. This has much to do with differences in opportunity. For example, adults have substantially more opportunities to take negative health risks because they have greater access to substances like alcohol, and have greater (or complete) behavioral autonomy and freedom. The age pattern in antisocial risk-taking is consistent with the “age-crime curve” that has been observed in many studies from various countries, where antisocial behavior rises and peaks in late adolescence and then subsequently declines among adults (Duell et al., 2018; Eisner, 2002). Recently, cross-sectional work has shown that positive risk-taking is more common in young adulthood than in adolescence, whereas negative antisocial risk-taking is more common in adolescence than in young adulthood (Fryt et al., 2021). Thus, there is evidence to suggest that different patterns of risk behavior are more prevalent across different ages. That said, it is unknown how patterns of positive and negative risk-taking vary across middle and late adulthood.

Research on the propensity for risk-taking across the life span (Josef et al., 2016; Mata et al., 2015; Mamerow et al., 2016) shows that risk propensity, or the inclination to take risks, increases from adolescence to middle adulthood, and then declines from 60 to 65 years of age. Also, research on domain-specific risk-taking (i.e. risk-taking in health/safety, ethical, financial, recreational, and social domains; Blais & Weber, 2006) shows that risk propensity reaches its highest levels around middle adulthood (Josef et al., 2016), although notable variations across domains emerge. For example, Rolison et al. (2013) suggest that risk-taking in health/safety (e.g. engaging in unprotected sex) and ethical (e.g. having an affair with a married man/woman) domains decrease linearly with age, while risk-taking in the social domain (e.g. disagreeing with an authority figure on a major issue) increases from young to middle adulthood and then declines in older age. Josef et al., (2016) suggest that risk-taking in the social domain is more stable across age than risk-taking in non-social domains. However, the relationship between risk propensity, domain-specific risk-taking, and age becomes more complex when factors such as sex, economic status, education, or

intelligence are taken into account (e.g. [Dohmen et al., 2011](#); [Frey et al., 2021](#)). It has also been shown that age differences in domain-specific risk-taking may result from different risk perceptions. For example, [Bonem et al. \(2015\)](#) found that older adults compared to young adults perceive risk-taking in the health/safety and ethical domains as more risky, and risk-taking in the social domain as less risky. Older adults also perceive risk-taking in the health/safety and ethical domains as less enjoyable and less likely to produce gains than young adults, and risk-taking in the social domain as more enjoyable and less likely to produce losses than young adults.

Age differences in risk-taking may also result from different motivations. In the study on developmental changes in personal goal orientation, [Ebner et al. \(2006\)](#) found that younger adults show a stronger orientation toward growth than toward maintenance or prevention of loss. Middle-aged adults show an increase in orientation toward maintenance and prevention of loss but still report a primary focus on growth. Finally, older adults show a lower orientation toward growth than young and middle-aged adults and rate their goals to similar degrees as being oriented toward growth, maintenance, and loss prevention. These differences have much to do with the fact that with increasing age, the ratio of gains to losses becomes more and more unfavorable. Although people of all ages want to achieve gains and avoid losses when making decisions, younger adults may be more motivated than older adults to achieve gains. Older adults, in turn, may be more motivated than young adults to avoid losses when making decisions ([Depping & Freund, 2011](#)). Based on such findings, it is evidence that risk-taking is a multidimensional construct and its prevalence and motivations vary over the life course.

Considering that positive risk-taking is likely to be an opportunity to gain significant benefits in a socially acceptable way ([Duell & Steinberg, 2021](#)), we could expect it to be quite stable across age. However, at different times of life, it can be driven by different motivations. For example, in adolescence and young adulthood, taking positive risks may be driven by exploration. Adolescents are known to explore novel environments more than young adults in behavioral tasks ([Lloyd et al., 2021](#)), but in real life, their opportunities to do so may be limited (just as they are for risk-taking). As many 20–30-year-olds are still in their identity exploration period (e.g. exploring careers, developing intimate relationships, changing place of residence frequently) ([Twenge & Park, 2019](#); [Willoughby et al., 2021](#)), they have plenty of opportunities for taking positive risks (many friendships to initiate, clubs to join, challenging courses to take). This could contribute to a peak in positive risk-taking in young adulthood. In turn, in middle adulthood, individuals may take positive risks in the service of long-term goals. During middle adulthood, many individuals focus on career or family goals ([Kitayama et al., 2020](#)), and potential gains from some positive risks such as a promotion, winning a competition, or taking leadership can be especially valuable. Given the developmental changes in goal orientation ([Depping & Freund, 2011](#)), we could also expect that young and middle-aged adults take positive risks for self-growth (e.g. trying a new sport to improve physical fitness or acquire a new skill), while older adults take positive risks to maintain their functioning on a satisfactory level (e.g. trying a new sport to stay fit or keep a good mood). However, since positive risk-taking has not yet been measured in middle and older adults, any predictions should be made with caution.

To this end, we are interested in examining age patterns in positive and negative (health and antisocial) risk-taking. So far, prior work using factor analysis has shown that positive risks load onto a single factor rather than having sub-domains. We also know from prior work that antisocial and health risks are distinct and follow unique age patterns (e.g., [Duell et al., 2018](#)). Given the dearth of literature on positive and negative risk-taking among adults, little is known about how engagement in these behaviors differs across age. Prior work indicates that positive risk-taking and negative health risk-taking are greater in young adulthood than in adolescence (e.g. [Fryt et al., 2021](#); [Willoughby et al., 2021](#)), but we don't know if age differences occur in later periods.

Certainly, the knowledge of different patterns of risk behavior across age can lay the foundation for future work on how positive, instead of negative risk-taking may be promoted (i.e., at school, at work, in the community, during retirement).

Furthermore, we are interested in examining to what extent positive and negative risk-taking are associated with risk-taking in different life domains. As opportunities for positive risks are often abundant in social (e.g. asking someone new on a date, standing for what you believe is right) and academic/work settings (e.g. running for a leadership role, enrolling in a challenging course), they might be associated with risk-taking in the social domain. As negative risks are often dangerous to health or life and antisocial (e.g. driving after drinking alcohol or taking drugs, threatening someone), we may expect their association with risk-taking in health/safety and ethical domains. However, in the case of negative risks, other associations cannot be excluded. Negative antisocial risks (e.g. getting into a fight) can also be considered as risks taken in the social domain (and a positive association between them and risk-taking in the social domain could be expected). It is, however, unlikely, because all risks in the social domain of the Domain-Specific Risk-Taking Scale ([Blais & Weber, 2006](#)) are socially accepted (e.g. "Choosing a career that you truly enjoy over a more secure one"), and those violating norms (e.g. "Having an affair with a married man/woman") are included in the ethical domain. Recently, one of the studies on young adults found that positive risk-taking was explained by risk-taking in the social domain, whereas negative risk-taking was explained by risk-taking in all domains except social ([blinded for review]). Ultimately, the knowledge gained from the study can contribute to the validity of positive risk-taking as a construct distinct from negative risk-taking.

1.3. Aims of the study

There were two aims of this study. The first aim was to examine whether positive and negative risk-taking vary across age, and at what age individuals take the most risks. In a sample of adolescents and adults ages 12–71 years, we hypothesized that positive and negative (health and antisocial) risk-taking vary significantly with age; the greatest endorsement of positive and negative health risk-taking is in young adulthood, whereas endorsement of negative antisocial risk-taking is greatest among adolescents. We divided negative risk-taking into health and antisocial domains given the prior literature suggesting that they are distinguishable patterns of risk behavior with distinct age patterns ([Duell et al., 2018](#); [Fryt et al., 2021](#)).

The second aim of the study was to examine to what extent positive and negative risk-taking are explained by risk-taking in different life domains (ethical, financial, health/safety, social and recreational) and risk-taking propensity. Because the measure of domain-specific risk-taking is designed for adults, we could only test our predictions in a sample of adults ages 19–71 years.¹ We hypothesized that greater positive risk-taking is associated with greater social risk-taking and that greater negative risk-taking is associated with greater risk-taking in the ethical and health/safety domain. We expected this because opportunities for positive risks are plentiful in social and academic/work settings, while negative risks are by definition either illegal/unaccepted or dangerous. We also expected both greater positive and greater negative risk-taking is associated with greater risk-taking propensity. We expected this given the evidence that different types of risk are driven by a shared risk propensity ([Frey et al., 2017](#)).

¹ The DOSPERT scale ([Blais & Weber, 2006](#)) is designed for adults. To our best knowledge, its adolescent version has already been developed ([Finger et al., 2015](#)) and is currently validated ([Blankenstein et al., 2021](#)).

2. Method

2.1. Participants

Three hundred ninety-four White, Polish adolescents and adults (283 women, 111 men) ages 12–71 ($M = 31.99$, $SD = 15.98$) participated in the study. Participant distribution across age cohorts is presented in Table A in the Appendix. The sample included adolescents and adults living in both small and large towns in Poland. Adolescents were students at primary schools, vocational schools, and high schools; 3 % of adults described their education as vocational, 25 % as secondary, and 72 % as higher (which means ongoing or completed bachelor's or master's studies). All participants provided written informed consent (in the case of adolescents under 18, written consent of the parent prior to youth assent was required).

2.2. Measures

2.2.1. Positive risk-taking scale (PRTS)

To assess positive risk-taking, we used the self-report scale developed by Duell and Steinberg (2020). The scale was translated into Polish, then back-translated and checked by the author. The scale consists of 14 positive risk behaviors. Because the scale was originally designed for adolescents, we used a slight modification of it for our adult participants. Firstly, we changed the item: "Tried out for a team or auditioned for a play when you were not sure you would be picked" to: "Applied for a job, project or participated in a competition when you were not sure you would be selected".² Secondly, we made a minor modification to three items: "Ran for a leadership role at work (instead of in school) or in some other organization when you were not sure you could be picked"; "Started learning something that (instead of: Taken a class in a subject) you knew nothing about or that seemed challenging"; and "Started a friendship with someone new when you were not sure how others (instead of: your other friends) would react". The full list of behaviors with an indication of which ones have been modified for adult participants is presented in Table B in the Appendix. Adolescents and adults rated how often they took each risk over the last year,³ using a 5-point scale from 1 – "never" to 5 – "very often". We changed the response format from the original 4-point scale from 1 – "none" to 4 – "more than 5 times" to avoid forcing participants to choose specific frequencies, which are likely to be inaccurately reported. The sum of points to all items is a frequency score of positive risk-taking (PRTS). The higher the score, the more frequent the positive risk-taking. In the present study, Cronbach's α of the PRTS was .79 (original version used in adolescents) and .83 (modified version used in adults).

2.2.2. Negative risk-taking scale (NRTS)

To assess negative risk-taking, we selected 23 behaviors that met the criteria of negative risk-taking from the Risk-Behavior Questionnaire developed for the purpose of our previous studies (Fryt et al., 2021). Since many negative risks are inaccessible to teenagers (e.g. risky driving), to assess negative risk-taking in participants ages 12–18 years,

² This is the only item on the scale where we decided to change the assessed activity. Trying out for a team or auditioning for a play may be more accessible at school than at work. Applying for a job, project, or participating in a competition appears to be a good adult counterpart and carries a similar risk of being rejected.

³ This study was conducted during the SARS-CoV-2 pandemic (in January and February 2021). To minimize potential biases in participants' access to risk behaviors, participants rated how often they took risks over the last year instead of the last six months (as in the original version of the PRTS scale). During this year the restrictions related to COVID-19 in Poland were not large, however, we cannot completely exclude that the participants took less risk this year than in other years.

we selected 7 out of 23 behaviors that can be endorsed by both adolescents and adults. These items have been used in previous studies of negative risk-taking among adolescents (Duell et al., 2018). Three of the negative risk items were negative health behaviors: drinking alcohol, smoking cigarettes, and smoking marijuana; four were antisocial behaviors: getting into a fight, threatening someone, vandalism, and stealing (shoplifting). Thus, in adolescents (12–18 y.o.) negative risk-taking was assessed with only these 7 behaviors, while negative risk-taking in adults (19–71 y.o.) was assessed with all 23 items. The full list of behaviors with an indication of which ones were used in adolescents is presented in Table B in the Appendix). Participants assessed how often they took each risk over the previous year, using a 5-point scale from 1 – "never" to 5 – "very often". An indicator of negative risk-taking (NRTS-23 in adults and NRTS-7 in adolescents) was the sum of points to all items (the higher the score, the more frequent the negative risk-taking). Cronbach's α of the NRTS-23 was .82, for the NRTS-7 it was .83, for the three negative health behaviors assessed in both adolescents and adults (NRTS-7H) it was .81, and for the four antisocial behaviors assessed in both adolescents and adults (NRTS-7A) it was .80.

2.2.3. Domain-specific risk-taking scale (DOSPERT)

To assess risk-taking in different life domains in adults (19–71 y.o.), we used the scale of Blais and Weber (2006) in Polish translation of Michalaszek-Geerdink (2013)⁴ which is designed for adults. The scale contains 30 risky behaviors originating from 5 life domains: ethical (E; e.g. passing off somebody's else work as your own), financial (F; e.g. betting a day's income on the outcome of a sporting event), health/safety (H/S; e.g. engaging in unprotected sex), social (S; e.g. disagreeing with an authority figure) and recreational (R; e.g. camping in the wilderness). Participants are presented with scenarios and asked how likely it is that they would endorse certain risks if they were to find themselves in those situations. The answers are assessed on a 7-point scale from 1 – "extremely unlikely" to 7 – "extremely likely". The sum of points to all items in a given subscale is the measure of risk-taking in a given domain. Cronbach's α of the general score was .85, for the ethical domain it was .63, for the financial domain .80, for the health/safety domain .63, for the social domain .74, and for the recreational domain .77. These results are comparable to those obtained by the authors of the original scale (Blais & Weber, 2006).

2.2.4. Risk-taking propensity

To assess individual differences in their willingness to take risks in general, adult participants (19–71 y.o.) answered a single question: "How would you rate your risk propensity on a scale from 1 – I am not willing to take risks to 10 – I am very willing to take risks?". A similar question for measuring this variable was used in the German Socio-economic Panel Study (SOEP, Dohmen et al., 2011; Josef et al., 2016; Wagner et al., 2007). Since this question has been used in adult studies so far, we only used it in adult participants.

2.3. Procedure

The data presented in this paper was collected in two separate studies on adolescents (12–18 y.o.) and adults (19–71 y.o.). Both studies were approved by the Ethical Committee of Institute of Psychology, Pedagogical University of Krakow. Adolescents were recruited in schools and participated in the study online. Invitations to participate in the study were sent to schools and parents, and parents who agreed to the study provided their children with a link to the online survey. Adults were recruited on social media and participated in the study online. All participants were assured confidentiality and the opportunity to ask questions (by e-mail), withdraw from the study at any time, and receive

⁴ The scale is available at the official DOSPERT webpage: <https://www8.gsb.columbia.edu/decisionsciences/research/tools/dospert>.

information about their results. There were no rewards for participation. Adolescents completed two questionnaires measuring positive and negative risk-taking (PRTS and NRTS-7). They also completed questionnaires assessing their peers' positive and negative risk-taking, risk perception (assessing how often their friends take given risks and how risky these risks are with additional questions on positive and negative risk-taking scales), and perceived social support (The Multidimensional Scale of Perceived Social Support, Buszman & Przybyła-Basista, 2017), but these data were not analyzed for the present paper. Adults completed three questionnaires measuring positive, negative, and domain-specific risk-taking (PRTS, NRTS-23, and DOSPERT), and answered one question about their risk-taking propensity. They also completed questionnaires assessing tolerance to ambiguity, future time perspective, and satisfaction with life, but these data were not analyzed for the present paper. Both for adolescents and adults the survey lasted 20–25 min, and since this was not long, no attention checks were implemented.

3. Results

3.1. Risk-taking age patterns in a sample of adolescents and adults aged 12–71

In confirmatory factor analysis conducted for the purpose of our previous study ([blinded for review]), we confirmed that positive and negative (health and antisocial) risk-taking are independent constructs. To test the hypotheses regarding age patterns (12–71 y.o.) in positive and negative risk-taking, we conducted a series of regression analyses in IBM SPSS Statistics 24 software. We were interested in whether age linearly or in an inverted-U shape is related to various types of risk-taking (in accordance with hypotheses). To test the shape of the relationships, we used a stepwise regression approach. We introduced gender and age as predictors in the first step of analysis and gender, age, and squared age in the second step. Gender was included in the models as a controlled variable. Risk-taking types were dependent variables in each analysis. We do not provide a standardized β estimate in the quadratic models in light of work suggesting these standardized regression coefficients may be fallible (Fox, 2008) – values may be overestimated and hard to interpret. Descriptive statistics and matrix correlations for PRTS and NRTS-7A/NRTS-7H (raw data) are found in Appendix Table C, and detailed results for regression models (gender, age, age squared – predictors, PRTS, NRTS-7A, NRTS-7H – dependent variables) can be found in Table 1. Because positive and negative risk-taking were measured on different ranges of scales, to make it easier to compare models presented in the figures, we standardized PRTS, NRTS-7A, and NRTS-7H.

First, we tested age patterns in positive risk-taking across adolescence and adulthood. In a sample 12–71 y.o. we conducted linear regression analysis with gender and age as predictors and PRTS as a dependent variable ($F_{(2,391)} = 4.98, p = .007, R^2 = .02$). Then, we fit a

quadratic regression model ($F_{(3,390)} = 7.91, p < .001, R^2 = .05$) that was a better fit to the data than the linear model ($R^2 \Delta .03, p < .001$). Visual inspection of the data suggests that positive risk-taking varies with age in the form of inverted-U shape and peaks in middle adulthood (see Fig. 1). Gender and age explained only 5 % of variation of positive risk-taking.

Then, we tested age patterns in negative antisocial risk-taking. We fitted a linear model ($F_{(2,391)} = 21.25, p < .001, R^2 = .09$) in which gender and age were the predictors and NRTS-7A was the dependent variable and a quadratic model ($F_{(3,390)} = 17.52, p < .001, R^2 = .11$) in which age squared was added as a predictor and NRTS-7A as a dependent variable. We compared both models and the results indicated that the quadratic model was a significantly better fit to the data than the linear model ($\Delta R^2 = .02, \Delta p < .001$). Visual inspection of the data suggests that negative antisocial risk-taking varies with age in the form of U shape and is greatest among adolescents (see Fig. 2). Gender and age explained 11 % of variation of negative antisocial risk-taking.

Finally, we tested age patterns in health risk-taking. We fitted a linear model ($F_{(2,391)} = 11.34, p < .001, R^2 = .05$) with gender and age as predictors and NRTS-7 H as a dependent variable and quadratic model ($F_{(3,390)} = 19.85, p < .001, R^2 = .13$) with gender, age, and age squared as predictors and NRTS-7 H as a dependent variable and then we compared the model fit. The results indicated a quadratic effect of age on negative health risk-taking ($\Delta R^2 = .08, \Delta p < .001$). Visual inspection of the data suggests that negative health risk-taking varies with age in the form of inverted-U shape and peaks in middle adulthood (see Fig. 3). The model explained 13 % of variance of health risk-taking.

3.2. Associations between domain-specific risk-taking with positive and negative risk-taking in a sample of adults aged 19–71

To establish associations between domain-specific risk-taking and risk-taking propensity with positive and negative risk-taking, we conducted a series of linear regression models in IBM SPSS Statistics 24 software. Descriptive statistics and matrix correlations for variables age, RTP, PRTS, NRTS-23, E, F, HS, R, S (ages 19–71 y.o.) are presented in Appendix Table D. Detailed results for regression models (squared age, gender, RTP, E, F, HS, R, S – predictors, PRTS, NRTS-23 – dependent variables) can be found in Table 2.

Regression Model 1 tested whether greater positive risk-taking was associated with greater risk-taking in the social domain and greater risk-taking propensity. The model controlled for gender and squared age. Independent variables included risk-taking propensity, ethical, financial, health/safety, recreational, and social risk-taking domains; positive risk-taking was the dependent variable. Model 1 explained 25 % of variance of positive risk-taking ($F_{(8,266)} = 12.54, p < .001, R^2 = .25$). Consistent with our hypothesis greater risk-taking in the social domain and greater risk-taking propensity were significantly related to greater positive risk-taking (see Table 2). No other variables were associated

Table 1
Linear and quadratic model coefficients for positive and negative risk-taking in adolescents and adults (12–71 y.o.).

Linear model	PRTS					NRTS-7A					NRTS-7H				
	b	SE	β	t	p	b	SE	β	t	p	b	SE	β	t	p
Constant	37.81	0.97		39.05	< 0.001	5.72	0.20		28.16	< 0.001	5.01	0.29		17.49	< 0.001
Gender	-1.32	0.95	-0.07	-1.39	0.17	0.88	0.20	0.21	4.42	< 0.001	0.39	0.28	0.07	1.39	0.17
Age	0.08	0.03	0.15	2.97	0.003	-0.03	0.01	-0.25	-5.25	< 0.001	0.04	0.01	0.22	4.38	< 0.001
Quadratic model															
Constant	31.09	2.07		15.05	< 0.001	6.89	0.44		15.82	< 0.001	1.89	0.60		3.17	< 0.01
Gender	-0.73	0.95		-0.77	0.44	0.78	0.20		3.89	< 0.001	0.66	0.27		2.42	< 0.05
Age	0.53	0.13		4.22	< 0.001	-0.11	0.03		-4.07	< 0.001	0.25	0.04		6.73	< 0.001
Squared age	-0.01	0.01		-3.67	< 0.001	0.01	0		3.03	< 0.01	-0.01	0		-5.91	< 0.001

N = 394; PRTS – positive risk-taking; NRTS-7A – negative antisocial risk-taking (vandalizing, threatening, stealing, getting into a fight); NRTS-7H – negative health risk-taking (smoking cigarettes, drinking alcohol, smoking marijuana). We do not provide β in quadratic models because standardized regression coefficients may be fallible (Fox, 2008). Gender was coded as follows: 0-women, 1-men.

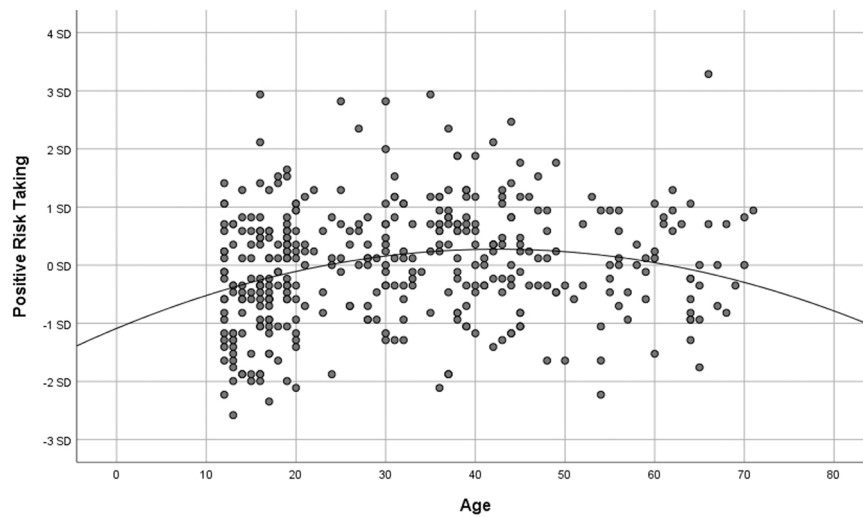


Fig. 1. Quadratic linear model in the group aged 12–71 in which positive risk-taking is the dependent variable and age is the independent variable. Y-axis represents the standardized z-score for PRTS. N = 394.

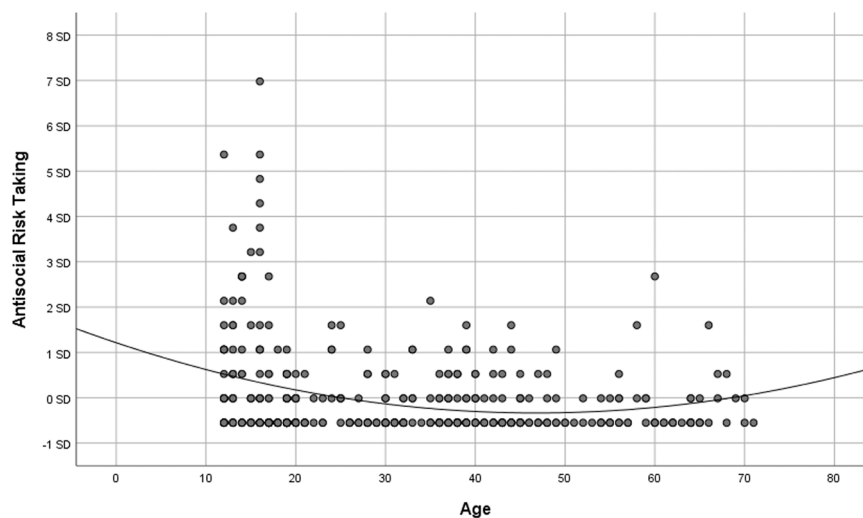


Fig. 2. Quadratic linear model in the group aged 12–71 in which negative antisocial risk-taking is the dependent variable and age is the independent variable. Y-axis represents the standardized z-score for NRTS-7A. N = 394.

with positive risk-taking.

In Regression Model 2, we tested whether greater negative risk-taking was associated with greater risk-taking in the ethical and health/safety domain, and greater risk-taking propensity. The model controlled for gender and squared age. Independent variables of interest were risk-taking propensity, ethical, financial, health/safety, recreational, and social risk-taking domains; negative risk-taking (NRTS-23) was the dependent variable. Model 2 explained 36 % of variance of negative risk-taking ($F_{(8,266)} = 20.35, p < .001, R^2 = .36$).

Consistent with our hypothesis greater negative risk-taking was related to greater risk-taking in the ethical and health/safety domains, and greater risk-taking propensity (see Table 2). We also observed greater negative risk-taking in men than in women.

4. Discussion

Our study is presumably the first that examines age patterns in positive and negative risk-taking – from early adolescence through late adulthood. Although initial findings on positive and negative risk-taking are already available, it is not known how positive risk-taking varies across the lifespan. We found that while positive and negative (health

and antisocial) risk-taking vary non-linearly with age, patterns of endorsement across different age groups vary. Whereas positive and negative health-risk taking seem to be greatest among middle adults, negative antisocial risk taking is greatest among late adolescents.

The finding that gender and age explain only 5 % of the variation of positive risk-taking suggests that the differences in positive risk-taking across adolescence and adulthood are not large and that other factors, such as opportunity, economic status, education (e.g., Dohmen et al., 2011; Frey et al., 2021), perhaps play a larger role. This interpretation is consistent with the view that each period of life offers opportunities to take positive risks, and that at any age there are goals (individual benefits) that can be achieved through positive risks (Duell & Steinberg, 2021). The fact that positive risk-taking is greatest in middle adulthood suggests that many positive risks are taken after a period of identity exploration (Twenge & Park, 2019; Willoughby et al., 2021), as people achieve greater stabilization in life and pursue long-term goals (Kitayama et al., 2020). Future studies on positive risk perception and the associations between positive risk-taking and goal orientation (Bonem et al., 2015; Ebner et al., 2006) should help determine whether age differences in positive risk-taking may result from different motivations. It is also possible that apart from sensation seeking and

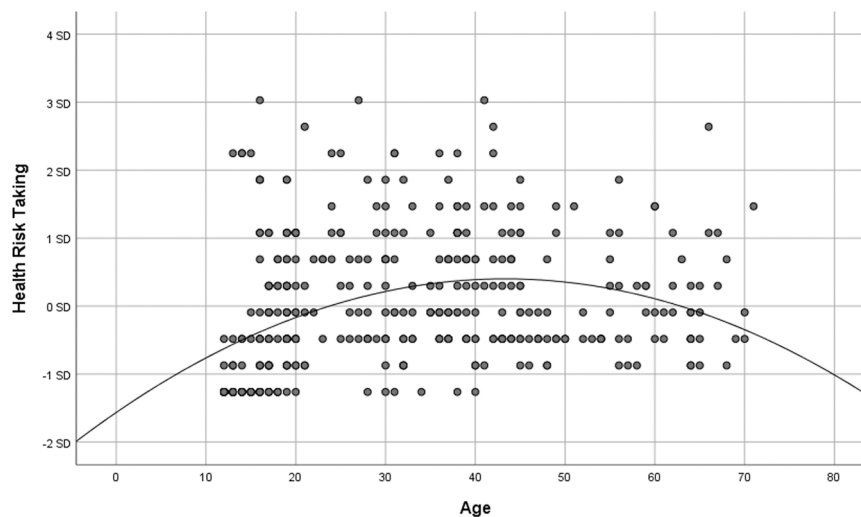


Fig. 3. Quadratic linear model in the group aged 12–71 in which negative health risk-taking is the dependent variable and age is the independent variable. Y-axis represents the standardized z-score for NRTS-7 H. N = 394.

Table 2
Predictors of positive and negative risk-taking in adults (19–71 y.o.).

Predictors	Model 1 PRTS					Model 2 NRTS-23				
	β	b	SE	t	p	β	b	SE	t	p
Constant		22.30	2.36	9.45	< 0.0001		19.19	2.06	9.30	< 0.001
Squared age	0.02	0.01	0.01	0.27	0.79	-0.04	0.01	0.01	-0.71	0.48
Gender	-0.06	-1.13	1.08	-1.05	0.29	0.24	4.20	0.94	4.46	< 0.001
Risk-Taking Propensity	0.28	1.15	0.24	4.86	< 0.001	0.21	0.79	0.21	3.83	< 0.001
Ethical domain	0.04	0.07	0.10	0.67	0.50	0.12	0.18	0.09	2.15	0.03
Financial domain	0.04	0.04	0.06	0.69	0.49	0.05	0.06	0.06	1.01	0.31
Health/Safety domain	-0.06	-0.07	0.08	-0.88	0.38	0.22	0.25	0.07	3.62	< 0.001
Recreational domain	0.07	0.08	0.07	1.09	0.28	0.12	0.12	0.06	1.84	0.07
Social domain	0.33	0.39	0.07	5.44	< 0.001	0.03	0.03	0.06	0.55	0.59

N = 275; PRTS – positive risk-taking; NRTS-23 – negative risk-taking (23 behaviors); Gender was coded as follows: 0–women, 1–men.

extraversion (Patterson et al., 2019), positive risk-taking is fostered by competencies acquired with life experience (e.g. coping in situations requiring social exposure and assertiveness, coping with the fear of failure). This is an exciting question for future research.

Findings regarding age patterns in negative risk-taking are consistent with the results of previous studies. We observed the greatest negative antisocial risk-taking among adolescents, consistent with the conventional “age-crime curve” observed in prior work (e.g., Duell et al., 2018; Eisner, 2002). Since the distribution of negative antisocial risk-taking was heavily skewed (as such risks as vandalizing, threatening, stealing, and getting into a fight are rarely taken), this result should be interpreted with caution. In turn, negative health risk-taking (smoking cigarettes, drinking alcohol, smoking marijuana) was greatest among individuals in middle adulthood. Although opportunities for negative risk-taking do not end with youth, one likely reason for the decline in antisocial risk taking among adults is that responsibilities and social roles (e.g. being a parent, employee) contribute to avoidance of antisocial risks with age (Duell & Steinberg, 2020). In contrast, opportunities for health-risk behaviors become more prevalent in adulthood and engagement in those behaviors (e.g., drinking or smoking) are more socially acceptable (Willoughby et al., 2021). Together, these results suggest that adolescence may be a key developmental period in which to develop interventions for negative antisocial risk-taking, whereas interventions aimed at reducing negative health risk-taking would be most beneficial to individuals in adulthood.

Results from this study also suggest that positive and negative risk-taking in adults are associated with risk-taking in different life domains. Specifically, positive risk-taking is associated with the

endorsement of social risks, whereas negative risk-taking is associated with endorsement of ethical and health/safety risks. Considering many of the potential gains and losses of positive risks are of a social nature (Duell & Steinberg, 2020) and that positive risk-taking is driven by extraversion (Patterson et al., 2019), these results are not surprising. Certainly, they may contribute to the validity of positive risk-taking as a construct distinct from negative risk-taking. Future research may help determine whether motivating positive risk-taking may be best achieved in social settings. Findings regarding the relationships between negative, ethical, and health/safety risks are consistent with our expectation that negative risks are by definition either illegal/unaccepted or dangerous. The relationship between negative and health/safety risks has also been found in previous studies, e.g. Farnham et al. (2018) showed that individual scores on health/safety domain of the DOSPERT scale were a predictor of negative health behaviors (i.e. substance use) in travelers both during travel and at home.

Despite being linked to risk-taking in different life domains, positive and negative risk-taking in adults are both associated with greater risk-taking propensity. This finding is consistent with the assumption that positive and negative risk-taking are driven by a shared propensity for risk (Duell & Steinberg, 2020) and consistent with the results of previous studies (Duell & Steinberg, 2020; Patterson et al., 2019) which showed that positive and negative risk-taking are positively correlated and associated with greater sensation seeking. It is also consistent with the findings suggesting a general factor of risk preference across different domains of risk-taking (Frey et al., 2017).

Noteworthy, positive and negative risk-taking in adults are not associated with age. Although this result may be surprising given the

wide age range of adult participants (19–71 y.o.), it seems to be consistent with the results obtained in the sample of adolescents and adults (12–71 y.o.). As the observed differences in positive risk-taking across adolescence and adulthood are not large (gender and age explain only 5 % of the variation of positive risk-taking), it is possible that they are even smaller across adulthood. Also, as the differences in negative (antisocial and health) risk-taking seems to be most apparent between adolescence and adulthood, they may be not visible in the sample of adults (however, due to the different number of negative risks analyzed in both samples, these results are difficult to compare).

Despite the novel contributions of our study to risk-taking literature, our work has some limitations that warrant consideration. Firstly, the study group is dominated by women, who take fewer negative risks than men, and among adults – by individuals with higher education. Also, the education of adolescents' parents was not collected, so the possible impact of education on risk-taking in tested sample was not controlled. While it is not yet known whether education affects whether individuals take more positive or negative risks, one may wonder if people with higher education have more opportunities to take positive risks (e.g. promotional opportunities, more time for interests and passions). Previous work on adolescents has also shown that positive risk-taking is associated with greater academic engagement whereas negative risk-taking is associated with less academic engagement (Duell & Steinberg, 2020). For this reason, it may be useful for future work to consider educational engagement and attainment as a moderator of risk-taking. Determining this in further research is crucial, along with controlling participants' social status (e.g. Dohmen et al., 2011).

Secondly, the results on the links between positive, negative, and domain-specific risk-taking across age are so far limited to adults. To have a complete picture of them the adolescent DOSPERT scale (Blankenstein et al., 2021; Figner et al., 2015) should be used in future studies. Moreover, the results on age patterns in negative risk-taking are based on seven behaviors and may not reflect age patterns in other negative risks, especially available only to adults. Although selecting such a small number of behaviors was dictated by the presence of early adolescents who do not have access to most negative risks, this could cause negative risk-taking in the age patterns analyses to be underestimated. Also, the modification in the Positive Risk-Taking Scale for adults, albeit small, could limit the comparability of the data. The change of the original response format could make our results and the results of Duell and Steinberg (2020) difficult to compare.

Also, only self-reports, single informant, were used in the study. Potentially adding additional informants or some of the behavioral measures of risk-taking should enhance the validity and reliability of the measures. There are also important age differences in risk-taking measured with self-report questionnaires and behavioral tasks (Defoe et al., 2015; Horn & Freund, 2022; Mata et al., 2011) which need to be considered in future work. Whereas real-world risk-taking is constrained by factors such as opportunities and social norms, risk-taking on experimental tasks may better capture a general propensity for risk that is not constrained by such factors (Duell et al., 2018). Finally, as the study is cross-sectional, we do not know how both types of risk change with age in the same individuals. Thus, whereas findings from the present study provide information about how risk behavior differs across various age groups, longitudinal work is needed to identify the developmental trajectory of various risk behaviors. The current study also do not provide knowledge about the possible birth cohort differences in risk-taking. Younger cohorts may be less willing to take risks (e.g. financial, Jianakoplos & Bernasek, 2006) than older ones due to decreasing financial and job security, as well as the latest threats of climate change, pandemic, and war.

The study was conducted during the SARS-CoV-2 pandemic. Despite the extension of the assessment of positive and negative risk-taking to a year and the fact the restrictions related to COVID-19 in Poland were not large during this period, we cannot completely exclude that positive and negative risk-taking in the study is underestimated.

In future work, it is worth determining how positive and negative risk-taking is perceived. It is important both to confirm whether participants of different ages perceive selected behaviors as positive and negative risks, and how they assess their possible gains and losses. Identifying how specific motivations and opportunities for risk change over the life course would also be an exciting avenue for future research. We hope the findings from this study lay the groundwork for this future work.

Overall, our study highlights the importance of examining positive and negative risk-taking, not only in adolescence, but throughout life. As we demonstrate, positive risk-taking varies with age in the form of inverted-U shape and peaks in middle adulthood, which suggests that it may not only result from the exploration of a new environment (which is crucial at a young age), but also from competences acquired from life experience (e.g. knowing when it is worth taking certain risks and when it is better to avoid them). Future research should focus on the adaptability of risk at all ages, including identifying what purposes it may serve and what resources may require positive risk-taking at different times of life.

Competing Interests

Authors declare no conflict of interests.

Data Availability

All data have been made publicly available at the OSF repository and can be accessed at: https://osf.io/wfphx/?view_only=e80e2232f1b349318d6a7ed2d5da1ae7.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.jallcom.2022.164017](https://doi.org/10.1016/j.jallcom.2022.164017).

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