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Domain-specific risk attitudes and aging—A systematic review

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Abstract

Risk attitudes have a significant impact on human decision making. In contrast to the conventional assumption of stable, universal risk attitudes, previous research has found domain-specific and age-related differences in risk attitudes. For this reason, a systematic review including 19 studies was conducted to evaluate the relationship between self-reported risk attitudes and aging in different domains of decision making. The results suggest a negative relationship between aging and self-reported risk attitudes. Age-related differences in risk attitudes also vary between different domains. Nine studies examined general risk attitudes, with eight finding a negative relationship with aging. Eight out of 11 studies found a negative relationship in the financial domain. All nine studies in the health domain identified a negative association as well. The seven studies included in the social domain showed mixed results. All six studies in the recreational domain identified a negative association. Four out of five studies in the ethical domain found a negative relationship. The three studies included in the driving and career domain also showed negative relationships between risk attitudes and aging. Potential policy implications are discussed.

KEYWORDS

aging, domain-specific risk taking, risk attitudes, self-reported measures

1 | INTRODUCTION

Most decisions are characterized by at least some degree of risk and uncertainty. Whether to favor a risky operation to more conservative treatment, self-employment to regular employment, or investment in risky assets to risk-free assets—all these decisions involve decision making under uncertainty and are thus influenced by risk attitudes.

Although risk attitudes play an essential role in decision making, especially in psychology and economics, there remains an ongoing discussion on two issues (Frey, Pedroni, Mata, Rieskamp, & Hertwig, 2017). The first one addresses the psychometric properties of risk attitudes and whether they constitute a universal or multidimensional construct. The second issue deals with the temporal stability of risk attitudes.

In addition, there is still disagreement on how to measure risk attitudes appropriately. In general, self-reported and behavioral measures are distinguished. A variety of behavioral measures exists which attempt to assess real-world risk-taking behavior. Economists usually prefer behavioral measures as they can integrate incentive compatibility and suggest the behavioral relevance of a trait (Dohmen et al., 2011). Incentive-compatible designs involve an (usually financial) incentive to motivate individuals to behave according to their true underlying preferences. A widely used measure are lottery choices based on Holt and Laury (2002), which have also been adapted for gain and loss framing (see, Mather et al., 2012 for an example). Other frequently used behavioral measures are, for example, the Iowa Gambling Task (IGT) or the Balloon Analogue Risk Task (BART). However, these measures are quite costly and make large-scale studies difficult (Dohmen et al., 2011).

In contrast to behavioral measures, this review focuses on risk attitudes elicited via self-reports. Within these measures, individuals directly indicate their risk attitudes. Several self-reported measures have gained popularity. One example is the single item included in the German SOEP which asks respondents to rate their willingness to take risks in general (see, Dohmen et al., 2011). Another frequently used measure is the Domain-specific Risk-attitude Scale (DOSPERT) proposed by Weber, Blais, and Betz (2002) where respondents indicate their likelihood to engage in a specific risky behavior separately for five risk domains. This results in a risk attitude score for each different area of everyday life such as health or financial matters. Other measures include the one-item financial risk taking question asked in the Survey of Consumer Finances (SCF) (e.g., Yao, Sharpe, & Wang, 2011) and a similarity rating integrated in the World Values Survey (e.g., Mata, Josef, & Hertwig, 2016).

Despite their different approaches, both types of measures have been used interchangeably (Frey et al., 2017). This suggests that they measure the same psychological construct which leads back to the unresolved issues of construct universality and temporal stability.

Previous research found only low correlations between behavioral and self-reported measures for risk attitudes (e.g., Josef et al., 2016; Lönnqvist, Verkasalo, Walkowitz, & Wichardt, 2015; Mamerow, Frey, & Mata, 2016). This gives a first indication that these measures address in fact different components of the risk attitude construct. Additionally, Frey et al. (2017) showed that self-reported measures correlate stronger than behavioral measures. Also, a general factor of risk attitudes explained a significant amount of variance within self-reported measures but not within behavioral measures (Frey et al., 2017). This hints at a certain amount of convergent validity for self-reported measures, but not for behavioral measures.

Still there remains unexplained variance which can be attributed to more domain-specific factors (Mata, Frey, Richter, Schupp, & Hertwig, 2018). This is supported by previous evidence which suggests that risk attitudes are rather domain-specific (see Schildberg-Hörisch (2018), for a discussion). Although domains seem to correlate, empirical investigations found domain-specific variation in levels of risk attitudes (e.g., Dohmen et al., 2011; Rolison, Hanoch, Wood, & Liu, 2013). In conclusion, the construct of risk attitudes seems to include both universal and domain-specific components (Frey et al., 2017).

The stability of individual risk attitudes across time has also been questioned. While there is a high heterogeneity in study results, a vast amount of research indicates age-related changes in risk attitudes. As the relationship between risk attitudes and aging has only been systematically reviewed for behavioral tasks, the present review focuses on self-reported risk attitudes and age by domain.

In their meta-analysis, Mata et al. (2011) identify age-related differences in risky choice for tasks based on experience, with younger adults being more risk averse. However, there were no differences evident for tasks that did not require learning. In addition, within these two classifications, there exist differences as well. For example, younger adults were more risk averse than their older counterparts in the IGT. In contrast, younger adults were more risk-seeking in the BART. This suggests age-related differences in risk attitudes based on task characteristics. Mamerow et al. (2016) also identify a joint effect of age and lottery task characteristics on risk attitudes.

Other studies suggest consistently declining risk attitudes across the lifespan (e.g., Dohmen, Falk, Golsteyn, Huffman, & Sunde, 2017; Jianakoplos & Bernasek, 2006). Also, risk attitudes may differ across individuals. Cohort effects can lead to diverging levels of risk attitudes between individuals that were born in different cohorts (Malmendier & Nagel, 2011).

Risk-sensitivity theory and evolutionary theory might offer a theoretical basis for age-related changes in risk attitudes. Decision making under risk involves trade-offs between benefits, and associated costs and individuals become risk-prone in situations of need (Ellis et al., 2012; Mishra, 2014). In this sense, younger individuals are in higher need of material resources, mating needs, and social status which translates into higher risk taking at younger ages. This would increase potential benefits but also raise potential costs. In contrast, older individuals have usually met these needs which results in reduced risk taking at a higher age (Mata et al., 2011; Mishra, 2014). This line of argumentation also supports the domain-specificity of risk attitudes. As unnecessary risk taking bears high costs, it would be reasonable for individuals to only seek risks in domains with high needs but not in domains with low needs (Mishra, 2014).

In sum, risk attitudes are evaluated by self-reported or behavioral measures which show a different level of convergent validity, exhibit domain-specific variation, and change across the life course. In light of this evidence and the current challenges provoked by an aging society, it is imperative to further examine both the relationship between risk attitudes and aging and domain-specific differences within this relationship. To the author's knowledge, only the relationship between behaviorally elicited risk attitudes and aging has been reviewed systematically (see, Best & Charness, 2015; Mata et al., 2011). This is surprising especially when considering the higher convergent validity of self-reported measures and the following conclusion that self-reported measures seem to comprise more common components in the underlying construct of risk attitudes. This systematic review tries to close this gap by evaluating the relationship between self-reported risk attitudes and aging by domain.

2 | METHODS

This systematic review was conducted in accordance with the PRISMA recommendations (Moher, Liberati, Tetzlaff, & Altman, 2009).

2.1 | Data sources and search strategy

As risk attitudes have been examined in economics, psychology, and medicine, the following databases were searched to identify and retrieve relevant literature: Business Source Complete, EconLit, MEDLINE, SocINDEX, PsycINFO, and PsycARTICLES. Multiple search terms for risk attitudes were included to account for the variety of

expressions used in previous literature. Search terms included "risk preference(s)," "risk attitude(s)," "risk taking," "willingness to take risk (s)," "risk aversion," "risk tolerance," "risky choice," "risky decision making," and "risk propensity." These terms were combined with different wordings for age and aging. In the basic search, no limitations were applied. The search was conducted on August 29, 2019. An update was performed on March 24, 2020.

2.2 | Study selection process

Studies were included which explicitly investigated the relationship between age and risk attitudes based on self-reported measurements of the study participants. This ruled out studies which only considered age as a control, mediator or moderator variable. If the studies used a mixture of behavioral and self-reported measure for risk attitudes, they were only included if both measures were separable.[1] Following Best and Charness (2015) and Mata et al. (2011), studies should include an age comparison between a younger (18–35 years) and an older age group (65–85 years). If age was measured continuously, the participants' age range should cover at least 50 years. This assured a comparable age range between categorical and continuous measurements of age. It is essential to assess a wide age range as the development of risk attitudes across age groups is not always found to be linear (e.g., Dohmen et al., 2017; Rolison et al., 2013).

Any kind of reviews, comments, unpublished work, nonempirical, and animal studies were excluded. In addition, studies not written in English or German were not considered. Studies which examined risk attitudes in a specific context such as certain populations (e.g., cancer patients and financial investors) were excluded as these might not be representative for risk attitudes in general.

2.3 | Data extraction

From the included studies, data were extracted for study type (e.g., cross-sectional) and population, age range or groups, the type of measurement for age (e.g., continuous), the measurement tool for risk attitudes (e.g., DOSPERT), the assessed risk domain(s), and the identified relationship between risk attitudes and aging. If one article comprised different substudies such as two different populations or different measurement tools for risk attitudes, those substudies were treated as separate investigations of the relationship between risk attitudes and aging.

2.4 | Data synthesis

This systematic review includes a narrative and graphical synthesis of the relationship between risk attitudes and age. In this case, it was not possible to conduct a quantitative meta-analysis due to the heterogeneity in the examined studies. Generally, problems like limited evidence, methodological and data diversity, incomplete reporting of outcome or effect estimates, or different effect measures can make a useful quantitative analysis impossible (Higgins et al., 2019; McKenzie & Brennan, 2019).

Specifically in this review, challenges arose with respect to several of these aspects. The first one refers to the measurement of age and risk attitudes. Age has been included both as a continuous and a categorical variable. In case of categorical age variables, the amount of age groups varied as well as the age range they spanned (see Table 1 for more details). Also, when being measured continuously, age was included as a linear, quadratic, or cubic variable in statistical analyses. In addition, risk attitudes were measured on different scales with a varying number of levels that participants used to indicate their risk attitudes (see Section 3.1 for different scales). Furthermore, some risk domains only included a low number of studies (e.g., driving or career domain). This makes it difficult to differentiate by domain in meta-analysis (Borenstein, Hedges, Higgins, & Rothstein, 2009). Also, there were missing data in the quantitative results.

Nevertheless, there exist some possibilities to explore when a synthesis of evidence is restricted to a narrative form. One such option is the presentation of results in graphical forms like harvest or effect direction plots (Higgins et al., 2019; Thomson & Thomas, 2013). To give some idea of effect sizes and directions in the present study, a tabular summary of the effect sizes (see Table 2) and an effect direction plot (see Figure 1) are presented in the result section.

2.5 | Quality assessment

Quality assessment tools often refer to one specific type of study or intervention design. As the studies included in this review span a variety of different study designs, an existing checklist was adapted accordingly to evaluate study quality. For this purpose, the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) criteria were used and adjusted to fit the included studies' designs (Vandenbroucke et al., 2007). In addition, three categories were built to indicate if each study provided no, insufficient, or sufficient information for the respective item.

3 | RESULTS

3.1 | Study selection and characteristics

In total, the application of the search strategy yielded 5319 hits. After removing duplicates, titles and abstracts of the identified literature were screened. Afterwards, the full texts of potentially relevant studies were examined for their eligibility. Finally, 17 studies were included for analysis in the review. As two studies used two different populations each to assess the relationship between risk attitudes and aging, in total, 19 studies were evaluated. Figure 2 provides details on the study selection.

[1]This excluded measures like the risk tolerance scale by Grable and Lytton (1999) as it contains both self-reported as well as behavioral measures like lottery choices.

TABLE 1 Study characteristics and results

Title	Year	Author(s)	Study type	Study population	Age range/ age groups	Measurement of age	Measurement of risk attitudes	Assessed risk domain	Relationship between age and risk attitudes
Age, loss minimization	(2018)	Best and Freund	Cross-	130	19–29,	Continuous	DOSPERT	• Financial	No relationship
and the role of robability			sectional		30–59,		F subscale		
for decision making					60–80				
Age differences in risk:	(2015)	Bonem et al.	Cross-	176	18–83	Categorical	Adapted	• Health/Safety,	H, Eth: significant omnibus effect of age
perceptions, intentions			sectional		18–25,	(+ continuous)	DOSPERT	• Social,	on risk attitudes, significant differences
and domains					26–59,			• Ethical,	between all age groups, negative relation-
					60–83			• Environmental,	ship S, En, O: no significant effect of age
								• Other	on risk attitudes
			Cross-	182	18–83	Categorical	Selected	• Health/Safety,	H: significant omnibus effect of age on risk
			sectional		18–25,		items from	• Social,	attitudes, no differences between adult and
					26–59,		study 1	• Ethical	young adult group, negative relationship
					60–83		(Adapted		S: significant omnibus effect of age on risk
							DOSPERT)		attitudes, no differences between young
									adults and adults, no differences between
									adults and older adults, positive relationship

TABLE 1 (Continued)

Title	Year	Author(s)	Study type	Study population	Age range/ age groups	Measurement of age	Measurement of risk attitudes	Assessed risk domain	Relationship between age and risk attitudes
									Eth: significant omnibus effect of age on
									risk attitudes, significant differences between
									all age groups, negative relationship
Individual risk attitudes:	(2011)	Dohmen et al.	Cross-	21,947	>17	Continuous	Continuous general +	• General,	All domains: negative relationship, linear
measurement, determinants,			sectional	(general)			domain-	• Financial,	pattern
and behavioral consequences							specific	• Health,	
							risk ques-	• Recreational,	
							tion	• Driving,	
							(SOEP)	• Career	
Risk attitudes across the life	(2017)	Dohmen et al.	Cross-	DNB:	16–<80	Continuous	Six items	• Financial	**Cross-sectional:**
course			sectional	5100/year			regarding		**Without cohort/period effects:** negative
			+ Longi-				invest-		relationship, approx. linear pattern
			tudinal				ments		(descriptive results)
									With cohort/period effects: negative
									relationship, approx. linear pattern
									until age 65, flatter afterwards
									Longitudinal: negative relationship, approx.

(Continues)

TABLE 1 (Continued)

Title	Year	Author(s)	Study type	Study population	Age range/ age groups	Measurement of age	Measurement of risk attitudes	Assessed risk domain	Relationship between age and risk attitudes
									linear pattern until age 65, flatter afterwards,
									than cross-sectional analyses
			Cross-	SOEP:	17–<80	Continuous	General	• General	**Cross-sectional:**
			sectional	>20,000/			risk taking		**Without cohort/period effects:** neg-
			+ Longi-	year			question		negative relationship, approx. linear
			tudinal				(SOEP)		pattern (descriptive results)
									With cohort/period effects: negative
									relationship, approx. linear pattern
									until age 65, flatter afterwards
									Longitudinal: negative relationship,
									similar to cross-sectional analyses
Identifying robust	(2020)	Frey et al.	Longitudinal	916	17–89	Continuous	General +	• General,	All domains: negative relationship,
correlates of risk							domain-	• Financial,	linear pattern
preference: A systematic							specific	• Health,	
approach using specification							risk question-	• Social,	
curve analysis							(SOEP)	• Recreational,	
								• Driving,	
								• Career	
Does Medical Risk	(2018)	Hanoch et al.	Cross-	309	20–77	Continuous	DOSPERT-	• Health	Negative relationship with passive

TABLE 1 (Continued)

Title	Year	Author(s)	Study type	Study population	Age range/ age groups	Measurement of age	Measurement of risk attitudes	Assessed risk domain	Relationship between age and risk attitudes
Perception and Risk			sectional				M (active		risk taking, linear pattern
Taking Change withAge?							risk taking),		No relationship with active risk taking
							Passive Risk-		
							Taking Scale		
Financial risk taking	(2006)	Jianakoplos and Bernasek	Longitudinal	2427	18–95	Continuous	Financial	• Financial	Negative relationship, linear pattern
by age and birth cohort			(year: 1989)				risk taking		Older cohorts have higher risk attitudes,
			3323				question		Higher risk attitudes in 1995 compared
			(year: 1995)				(SCF)		with 1989 and 2001
			3439						
			(year: 2001)						
Stability and change	(2016)	Josef et al.	Longitudinal	44,076	18–85	Continuous	General +	• General	**Rank-order stability:** moderate to high,
in risk-taking			+ crosssectional	(general)		+ categorical	domain-	• Financial,	inverted U-shaped pattern across
propensity across				11,903			specific	• Health,	age co-horts
the adult lifespan				(domain)			risk ques-	• Social,	**Mean-level changes:**
							tion (SOEP)	• Recreational,	**General:**
								• Driving,	**Cross-sectional:** negative relationship,
								• Career	cubic pattern
									Longitudinal: negative relationship,
									quadratic pattern
									Domain-specific:
									Cross-sectional: negative relationship
									F, H, R, C: cubic pattern

(Continues)

TABLE 1 (Continued)

Title	Year	Author(s)	Study type	Study population	Age range/ age groups	Measurement of age	Measurement of risk attitudes	Assessed risk domain	Relationship between age and risk attitudes
									S: linear pattern
									D: quadratic pattern
									Longitudinal:
									F, H, S: no relationship
									R, C: positive relationship, cubic pattern
									D: negative relationship, linear pattern
Risk taking across	(2016)	Mamerow et al.	Cross-	902	18–90	Continuous	General	• General	Negative relationship, linear pattern
the life span: A			sectional				risk taking		
comparison of							question		
self-report and							(SOEP)		
behavioral measures									
of risk taking									
Propensity for	(2016)	Mata et al.	Cross-	147,118	15–99	Continuous	General	• General	Negative relationship, linear pattern
risk taking across			sectional				risk taking		
the life span and							question World		
around the globe							Values Survey		
Risk taking through	(1980)	Okun et al.	Cross-	126	18–78	Continuous	20 items	• General	No relationship
the adult life span			sectional				following		
							Knowles		
Risk, reward, and	(2012)	Roalf et al.	Cross-	59	21–85	Categorical	DOSPERT	• General	G, H, S, R: lower risk attitudes of older
economic decision			sectional					• Financial,	adults compared with younger
making in aging								• Health/Safety,	F, Eth: no relationship
								• Social,	
								• Recreational,	
								• Ethical	

TABLE 1 (Continued)

Title	Year	Author(s)	Study type	Study population	Age range/ age groups	Measurement of age	Measurement of risk attitudes	Assessed risk domain	Relationship between age and risk attitudes
Risk-taking differences	(2013)	Rolison et al.	Cross-	528	18–93	Continuous	DOSPERT	• Financial,	F, H, R, Eth: negative relationship, linear
across the adult life			sectional		18–39,			• Health/Safety,	pattern
span: A question of age					40–59,			• Social,	S: no relationship
and domain					60+			• Recreational,	
								• Ethical	
How well do we	(2017)	Rolison and Pachur	Cross-	444	19–85	Continuous	Self-reported	• Financial	Negative relationship, linear pattern
know our inner			sectional				likelihood		
daredevil? Probing							rating for		
the relationship							gambles		
between self-report									
and behavioral									
measures of risk									
taking									
Lifecycle patterns in	(2015)	Schurer,	Longitudinal	36,105	<20	Categorical	General	• General	**Without cohort effects:** Decreasing risk
the socioeconomic				(pooled	20–25,		risk taking		attitudes across age groups, significant dif-
gradient of risk				analysis)	…		question		ferences between all age groups except 41– 45
preferences				18,990	71–75,		(SOEP)		**With cohort effects and socioeconomic gradient:**
				(cohort	≥75				Negative relationship until age 45, afterwards
				analysis)					risk attitudes decrease in cohorts with low socio-

(Continues)

TABLE 1 (Continued)

Title	Year	Author(s)	Study type	Study population	Age range/ age groups	Measurement of age	Measurement of risk attitudes	Assessed risk domain	Relationship between age and risk attitudes
									economic status and stay constant or increase in
									ohorts with high socio-economics status
The Effects of Age, Priming,	(2016)	Wood et al.	Cross-	131	18–36,	Categorical	DOSPERT	• Financial,	F, H, R, Eth: older adults have lower risk
and Working Memory			sectional		60–83			• Health/Safety,	attitudes
on Decision-Making								• Social	S: no differences between age groups
								• Recreational,	
								• Ethical	
Decomposing the age	(2011)	Yao et al.	Cross-	21,167	27–79	Continuous	Financial	• Financial	Negative relationship, decrease in likelihood
effect on risk tolerance			sectional				risk taking		for indicating any level of risk attitudes
							question		**Cohort effects:** no relationship
							(SCF)		**Period effects:** decrease in risk attitudes
									from 2001 to 2004

Note: Domains: G: General, F: Financial, H: Health/Safety, S: Social, Eth: Ethical, R: Recreational, D: Driving, Career/Occupational: C, Sports/Leisure: S, Environmental: En, Other: O.

TABLE 2 Effect sizes of included studies

Study	General	Financial	Health	Social	Recreational	Ethical	Driving	Career/Occupational	Environmental	Other
Best and Freund, (2018)		−0.03[a]								
Bonem et al. (2015)			Y: 3.18 [1.06]	Y: 4.57 [0.96]		Y: 2.58 [1.07]			Y: 2.71 [1.04]	Y: 2.84 [1.08]
			A: 2.77 [1.19]	A: 4.87 [1.13]		A: 1.97 [1.08]			A: 2.95 [1.17]	A: 3.03 [1.04]
			O: 1.85 [0.82][b]	O: 4.88 [0.95]		O: 1.51 [0.68]			O: 2.36 [0.99]	O: 2.53 [1.00]
			Y: 3.41 [1.05]	Y: 4.61 [0.91]		Y: 2.64 [1.10]				
			A: 3.21 [1.31]	A: 4.94 [1.15]		A: 2.28 [1.17]				
			O: 2.48 [1.02][c]	O: 5.26 [0.95]		O: 1.57 [0.71]				
Dohmen et al. (2011)	−0.034***	−0.025***	−0.036***		−0.063***		−0.050***	−0.059***		
	[0.001]	[0.001]	[0.001]		[0.001]		[0.002]	[0.002]		
Dohmen et al. (2017)		−0.021***								
		[0.001][d]								
	−0.022***									
	[0.001][d]									
Frey et al. (2020)	−0.09**[e]	NA	NA	NA	NA		NA	NA		
Hanoch et al. (2018)			−0.04 [NA];							
			−0.12** [NA][f]							
Jianakoplos and Bernasek (2006)		−0.023*								
		[0.012][g]								
Josef et al. (2016)	−0.023***	−0.017***	−0.018**	−0.161***	−0.047***		−0.089***	−0.032***		
	[0.006];	[0.007];	[0.009];	[0.024];	[0.011];		[0.012];	[0.011];		
	−0.030***	−0.049	−0.006	0.009	0.025**		−0.057**	0.027**		
	[0.011][h]	[0.026]	[0.027]	[0.026]	[0.012]		[0.028]	[0.014]		
Mamerow et al. (2016)	−0.27***									
	[0.10]									
Mata et al. (2016)	−1.98***									
	[0.11]									
Okun et al. (1980)	−0.17[a]									

(Continues)

TABLE 2 (Continued)

Study	General	Financial	Health	Social	Recreational	Ethical	Driving	Career/Occupational	Environmental	Other
Roalf et al. (2012)	Y: 197.89	Y: 17.07	Y: 21.36	Y: 29.43	Y: 26.75	Y: 13.29				
	[22.79]	[7.66]	[7.13]	[3.84]	[9.61]	[4.76]				
	O: 79.80	O: 14.60	O: 13.00	O: 26.67	O: 14.57	O: 10.97				
	[22.71][i]	[6.94]	[7.26]	[4.44]	[8.51]	[4.53]				
Rolison et al. (2013)		−0.27***	−0.42***	−0.09	−0.40***	−0.41***				
		[NA]	[NA]	[NA]	[NA]	[NA]				
Rolison and Pachur (2017)		−0.01**								
		[NA]								
Schurer	1: 1.11***[j]									
(2015)	2: 0.74***									
	3: 0.36***									
	4: 0.14***									
	5: −0.01									
	6: −0.13***									
	7: −0.22***									
	8: −0.31***									
	9: −0.32***									
	10: −0.40***									
	11: −0.52***									
	12: −0.88***									
Wood et al.		−0.373***[a]	−0.656***	−0.088	−0.581***	−0.483***				
(2016)										
Yao et al.		−0.0212***								
(2011)		[NA]								

Note: Standard errors and standard deviations in brackets. Young adults (Y), adults (A), and older adults (O). If cohort/period effects had been examined, the effect sizes of age when controlling for cohort and period were reported.

[a]Correlation coefficient.

[b]H: significant differences Y and A ($p < 0.05$), Y and O ($p < 0.01$), and A and O ($p < 0.01$); S, En, O: no significant differences between age groups; Eth: significant differences between Y and A ($p < 0.01$), Y and O ($p < 0.01$), and A and O ($p < 0.05$).

[c]H: significant differences between Y and O ($p < 0.01$), O and A ($p < 0.01$), no significant differences between Y and A; S: significant differences between Y and O ($p < 0.05$), no differences between Y and A, and A and O; Eth: significant differences between Y and A ($p < 0.01$), Y and O ($p < 0.01$), and A and O ($p < 0.05$).

[d]NA for longitudinal analyses.

[e]Only overall age effect reported; NA for single domains.

[f]Active risk taking; passive risk taking.

Except for one study from 1980, the identified literature spans a time frame from 2006 to 2018. The majority of studies was cross-sectional (13 out of 19); three studies included both cross-sectional and longitudinal analyses; eight studies were based on large-scale surveys such as the German Socio-Economic Panel Study (SOEP) or Surveys of Consumer Finances (SCF); 11 studies used smaller samples ranging from 59 to 916 participants. Because of the age-group-based inclusion criterion, the literature examines comparable age ranges. The largest age range spans participants from the age of 15 to 99 years. While 13 studies measured age continuously, four used categorical age variables and two used both continuous and categorical measures. The included studies use several measurement tools for risk attitudes. Seven studies use the Domain-Specific Risk-Taking (DOSPERT) Scale or an adapted form of this scale; six use the general risk-taking question of the SOEP, where three also retrieve the domain-specific risk attitudes; two studies use the financial risk tolerance item of the SCF. One study each applies the risk taking item of the World Values Survey, a Risk Taking Questionnaire developed by Knowles (1976), six items regarding financial investments retrieved in the DNB Household Survey, the medical domain of the Passive Risk-Taking Scale (Keinan & Bereby-Meyer, 2012), and a self-reported likelihood rating for gambles. The assessed risk domains contain the following areas: general, financial, health/safety, social, recreational, ethical, car driving, career/occupational, and environmental. Table 1 presents this information in condensed form.

Risk attitudes in the general domain usually refer to risk taking in life overall without any specification of situations or behaviors that characterize general risk attitudes. Often, this domain is assessed with the general risk taking question included in the SOEP (see, Dohmen et al., 2011). An exemption are Roalf, Mitchell, Harbaugh, and Janowsky (2012) who built a summary score across all DOSPERT domains which indicates general risk attitudes. The financial domain describes risk attitudes regarding any financial matters ranging from savings and investments to spending and lending money (e.g., Jianakoplos & Bernasek, 2006; Rolison et al., 2013). In the health/safety domain, risk attitudes are assessed not only with health behaviors like never wearing sunscreen or binge drinking (e.g.,Hanoch, Rolison, & Freund, 2018) but also with a general question asking how much risk an individual is willing to take in the health domain (e.g., Josef et al., 2016). This general question also exists for the social domain which is further addressed with risky behaviors like asking for a raise or disagreeing with a parent (e.g., Roalf et al., 2012). Risk attitudes in the recreational domain are again evaluated via a general question (e.g., Josef et al., 2016) or behaviors like camping in the wild (e.g., Roalf et al., 2012). To assess risk attitudes in the ethical domain, respondents are asked to indicate their likelihood of engaging in behaviors like cheating on your income tax or buying an illegal drug (e.g., Roalf et al., 2012). Risk attitudes for driving refer to car driving, whereas career or occupational risk attitudes involve occupational risks in general (e.g., Dohmen et al., 2011). For the environmental domain, respondents indicate their likelihood for engaging in behaviors like being exposed to nuclear waste or harmful bacteria in food (Bonem, Ellsworth, & Gonzalez, 2015).

[g]Model specification B was used as this is more comparable to birth cohort specifications in other included studies.
[h]Cross-sectional effects; longitudinal effects.
[i]G: significant difference between Y and O ($p < 0.01$); F: no significant difference between Y and O; H: significant difference between Y and O ($p < 0.01$); S: significant difference between Y and O ($p = 0.01$); R: significant difference between Y and O ($p < 0.01$); Eth: no significant difference between Y and O.
[j]OLS; see Table 1 for definition of age groups; reference group: age 36–40; NA for analysis with cohort effects.
*indicates significance at the 10%-level.
**indicates significance at the 5%-level.
***indicates significance at the 1%–level.

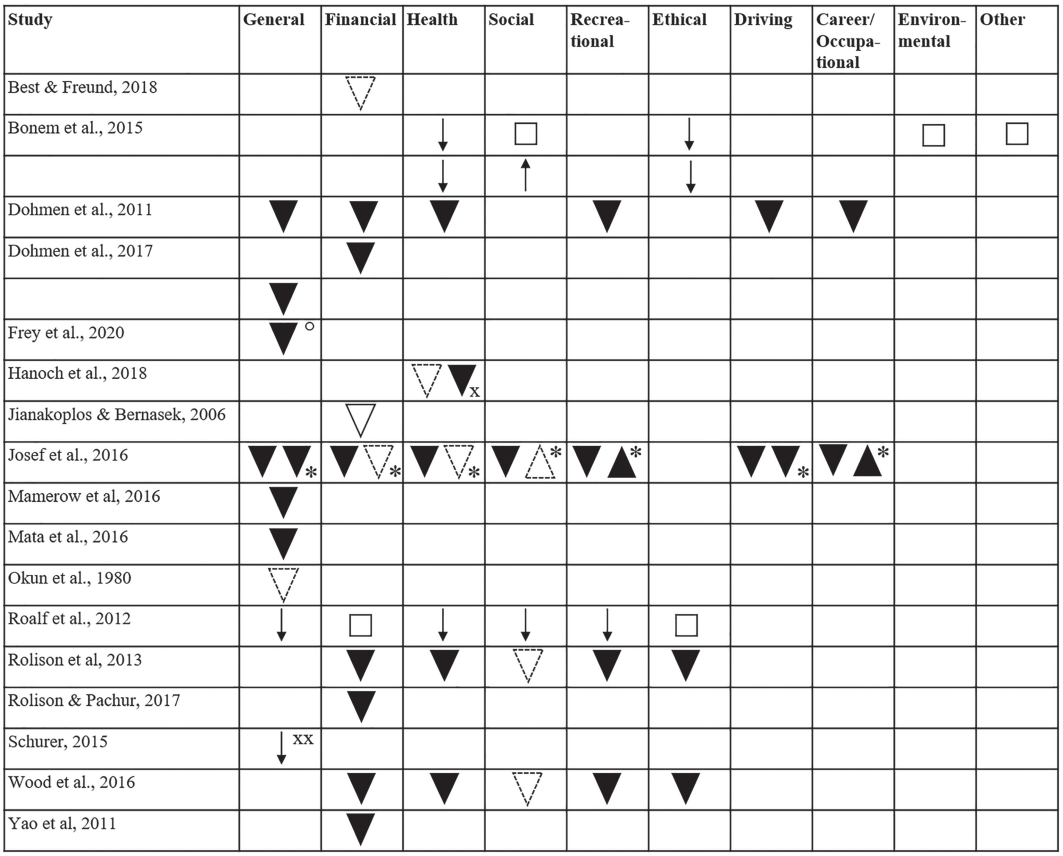


FIGURE 1 Effect direction plot

3.2 | Data synthesis

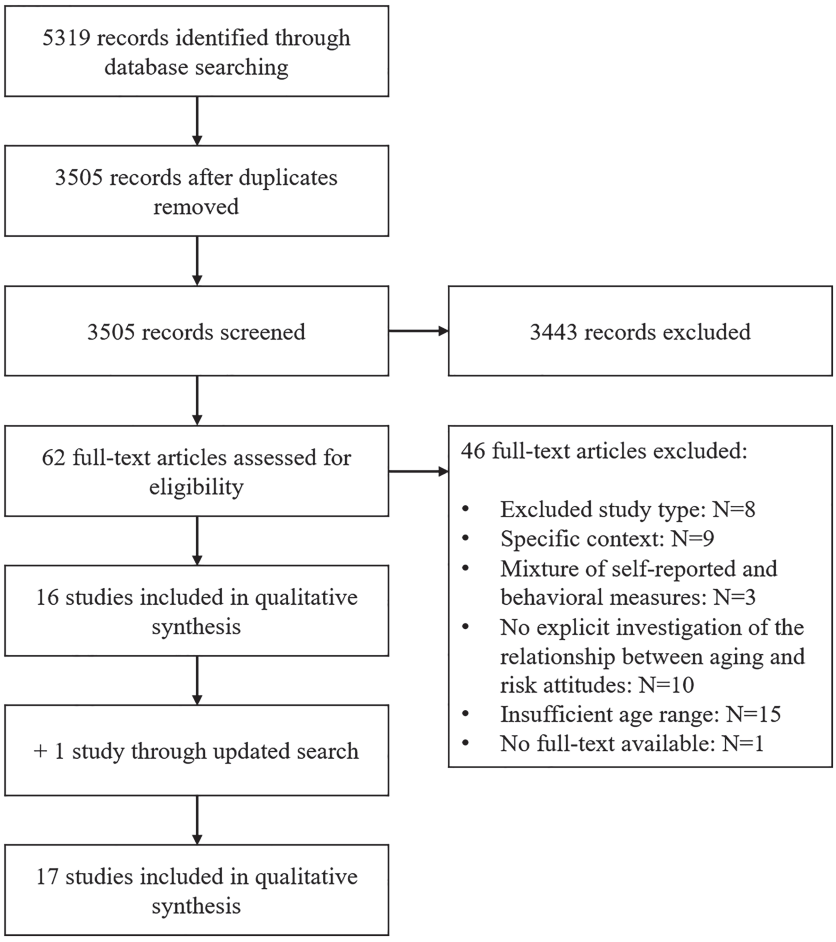
In the following, the individual study results with regard to the relationship between risk attitudes and aging are synthesized by assessed risk domain. A special focus is placed on the type of relationship (e.g., linear or quadratic patterns). Birth-cohort and period effects are examined separately. In accordance with the PRISMA guidelines (Moher et al., 2009), an interpretation of the results follows in Section 4.

3.2.1 | General risk domain

Nine studies evaluated the participants' risk attitudes in the general risk domain. Eight of those reported a negative association between risk attitudes and aging, whereas one did not find a significant relationship. However, there exist differences between the studies regarding the type of negative relationship. Dohmen et al. (2011), Frey, Richter, Schupp, Hertwig, and Mata (2020); Mamerow et al. (2016); and Mata et al. (2016) found a negative linear relationship. In addition, Roalf et al. (2012) showed lower risk attitudes for older adults compared with younger ones. Descriptive results of Dohmen et al. (2017) showed a negative relationship between age and risk attitudes for the SOEP population without controlling for birth-cohort and period effects as well. Also, when not controlling for birth-cohort effects, Schurer (2015) found decreasing risk attitudes across all examined age groups except one (41–45 years). When controlling for birth-cohort and period effects in the cross-sectional analysis, Dohmen et al. (2017) identified a linear relationship until the age of 65 with a flatter slope hereafter. Their longitudinal effects were similar to the cross-sectional ones. As Schurer (2015) controlled for birth-cohort effects, the relationship between risk attitudes and aging became nonlinear. This nonlinear relationship was considered separately for groups with high or low socio-economic status. Until the age of 45, risk attitudes of both groups decreased similarly. However, after the age of 45, risk attitudes decreased in cohorts with low socio-economic status and stayed constant or increased in cohorts with high socio-economics status.

Josef et al. (2016) analyzed the relationship between risk attitudes and aging with three different conceptualizations of change in risk attitudes: rank-order, mean-level, and individual-level stability. Rank-order stability signals "whether groups of people retain the same rank

FIGURE 2 Flow chart of study selection



ordering on trait dimensions over time" (Roberts & DelVecchio,2000, p.4). Mean-level stability describes the stability of a trait at the average level within a group of individuals. Individual-level stability refers to the stability of a trait within one individual (Josef et al., 2016). This type of stability will not be considered for analysis as it relates changes in risk attitudes to changes in other individual-level variables (e.g., the Big Five personality traits).[2] The authors found a moderate to high rank-order stability, that is, individuals with high-risk attitudes retained relatively high-risk attitudes over time compared with individuals with low-risk attitudes. When controlling for birth-cohort effects, an inverted U-shaped pattern emerged (Josef et al., 2016). With respect to mean-level stability, in both the cross-sectional and the longitudinal analysis, average levels of risk attitudes decreased with age.[3] Cross-sectional results identified a cubic pattern. In the longitudinal analysis, risk attitudes and aging were best described by a quadratic relationship. Risk attitudes decreased until the age of 60. From 60 years onwards, the decrease in risk attitudes became stronger. However, there was an overall decrease in mean risk attitudes across time. Okun, Stock, and Ceurvorst (1980) did not find a relationship between general risk attitudes and aging.

[2]The other studies included in this review did not specify the type of stability they investigated. However, it seems like all studies examined changes in mean-level stability.
[3]Only results of model A are included as the other models involve specific analyses regarding the role of gender in the relationship between risk attitudes and aging.

3.2.2 | Financial risk domain

Eleven studies assessed risk attitudes in the financial domain. The vast majority found a negative relationship between financial risk attitudes and aging (Dohmen et al., 2011, 2017; Frey et al., 2020; Jianakoplos & Bernasek, 2006; Josef et al., 2016; Rolison et al., 2013; Rolison & Pachur, 2017; Wood, Black, & Gilpin, 2016; Yao et al., 2011). Best and Freund (2018), Roalf et al. (2012) and Josef et al. (2016) in their longitudinal analysis found that age was not associated with changes in financial risk attitudes.

As in the general risk domain, there exist differences between the studies regarding the type of the negative relationship between risk attitudes and aging. Dohmen et al. (2011) established that the negative association between aging and risk attitudes played a smaller role in the financial domain compared with other contexts. In their DNB Household Survey sample, Dohmen et al. (2017) detected similar effects to their SOEP sample, which retrieved general risk attitudes. The negative relationship between financial risk attitudes and aging was approximately linear. But when controlling for birth-cohort and period effects, both cross-sectional and longitudinal analyses revealed an approximately linear decrease until the age of 65, which became flatter thereafter. However, the effects in the longitudinal analysis were smaller. Apart from a linear decrease of risk attitudes across the lifespan, Jianakoplos

and Bernasek (2006) also identified a birth-cohort and some period effects. Older birth cohorts had higher risk attitudes than younger ones. Also, economy-wide market developments seemed to reflect in changing risk attitudes. The study by Josef et al. (2016) detected different aging-based changes in risk attitudes in their cross-sectional and longitudinal analyses. In the cross-sectional investigation, the authors found a negative relationship between risk attitudes and aging which followed a cubic pattern. The decrease in risk attitudes was smaller until the age of 55 and became larger in the years after. In contrast, aging was not associated with risk attitudes in the longitudinal analysis. Both Frey et al. (2020), Rolison et al. (2013), and Rolison and Pachur (2017) identified a negative linear relationship between risk attitudes and aging. In addition, Wood et al. (2016) showed lower risk attitudes for older compared with younger adults. Yao et al. (2011) also differentiated the effect of aging on risk attitudes from birth-cohort and period effects. Although risk attitudes decreased continuously across the lifespan, there were no birth-cohort effects evident. Socio-economic developments seemed to reflect in changing risk attitude levels.

3.2.3 | Health risk domain

Nine studies included the evaluation of risk attitudes in the health domain. All of them found evidence for decreasing risk attitudes across the lifespan (Bonem et al., 2015; Dohmen et al., 2011; Frey et al., 2020; Hanoch et al., 2018; Josef et al., 2016; Roalf et al., 2012; Rolison et al., 2013; Wood et al., 2016). Again, different patterns emerged between the enclosed studies.

Dohmen et al. (2011), Frey et al. (2020), and Rolison et al. (2013) identified a linear trend, whereas Roalf et al. (2012) and Wood et al. (2016) showed lower risk attitudes for an older age group compared with a younger one. In their first study, Bonem et al. (2015) found that older adults had lower risk attitudes than adults which in turn had lower risk attitudes than young adults. In their second study with a reduced set of risk items, the authors identified lower risk attitudes for older adults compared with adults and young adults as well. However, there were no age differences in risk attitudes for adults and young adults. Hanoch et al. (2018) compared risk attitudes for active (e.g., donating a kidney) vs. passive (e.g., immediately go to the doctor's when something in my body is aching or bothering me) risk taking. Although aging had a linear negative relationship with risk attitudes for passive risk taking, there was no association with risk attitudes for active risk taking. In their cross-sectional and longitudinal analyses, Josef et al. (2016) detected similar aging effects in the health domain as in the financial domain. While there was an overall negative relationship between risk attitudes and aging in the cross-sectional analysis, the relationship pattern was cubic. Risk attitudes showed a small decrease until the age of 55 with a stronger decrease afterwards. In the longitudinal investigation, there were no age-related changes in risk attitudes.

3.2.4 | Social risk domain

In seven studies, risk attitudes in the social domain were assessed. The results were inconsistent across studies.

Josef et al. (2016) found a negative linear relationship between aging and risk attitudes in the cross-sectional analysis. However, the smallest effect size was detected in this domain in comparison with the others. Also, Roalf et al. (2012) established lower risk attitudes for older adults compared with younger adults.

However, there is also evidence for a missing link between aging and risk attitudes in this domain. In their first study, Bonem et al. (2015) found no age-related differences. In their second study, although finding lower risk attitudes for young compared with old adults and thus hinting at a positive relationship, there were no age differences detectable between young adults and adults as well as adults and old adults. Josef et al. (2016)'s results differed between their cross-sectional and longitudinal analysis. As mentioned above, in the cross-section, there was a negative linear relationship between risk attitudes and aging. In the longitudinal analysis, no age-related changes in risk attitudes emerged. Frey et al. (2020) and Rolison et al. (2013) could not find age-related differences in risk attitudes either. In addition, Wood et al. (2016) corroborated these findings by showing that young and old adults did not have different risk attitudes in the social context.

3.2.5 | Recreational risk domain

Six studies dealt with risk attitudes in a recreational context. Both Dohmen et al. (2011) and Frey et al. (2020) established decreasing risk attitudes with age which followed a linear pattern. Within Dohmen et al. (2011)'s study, the effect size in this domain was the largest across all examined domains. In the cross-section, Josef et al. (2016) found a negative relationship between risk attitudes and aging which followed a cubic pattern. The decrease in risk attitudes was stronger before the age of 40 than afterwards. In the longitudinal analysis, the pattern was cubic as well. However, the relationship was positive. Roalf et al. (2012) and Wood et al. (2016) reported higher risk attitudes for young compared with old adults. Rolison et al. (2013) detected a negative relationship between risk attitudes and aging which followed a linear pattern.

3.2.6 | Ethical risk domain

In total, five studies evaluated risk attitudes in the ethical domain. Four of them detected a negative relation between aging and risk attitudes (Bonem et al., 2015; Rolison et al., 2013; Wood et al., 2016), whereas one does not find an effect (Roalf et al., 2012).

In both their studies, Bonem et al. (2015) established that young adults had higher risk attitudes than adults, which in turn had higher risk attitudes than old adults. As in the health risk domain, Rolison et al. (2013)'s study reported overall decreasing risk attitudes. This

trend was linear. Wood et al. (2016) detected lower risk attitudes for older adults compared with younger ones.

3.2.7 | Driving risk domain

Three studies determined risk attitudes with respect to car driving. Dohmen et al. (2011) and Frey et al. (2020) identified a linear decrease in risk attitudes across the lifespan. In both the cross-sectional and longitudinal analysis, Josef et al. (2016) found overall decreasing risk attitudes with aging as well. This relationship could be described best by a quadratic one in the cross-section. Risk attitudes were highest in young adulthood (between the ages 20 and 30), while decreasing afterwards. Longitudinal effects showed a linearly decreasing trend for risk attitudes with age.

3.2.8 | Career/occupational risk domain

Also, three studies assessed risk attitudes in the career domain. Dohmen et al. (2011) established a relatively strong, negative linear relation between aging and risk attitudes in this context. Frey et al. (2020)'s findings suggested a negative linear association as well. Josef et al. (2016) found a negative relationship between risk attitudes and aging in the cross-section, but a positive one in the longitudinal analysis. In both analyses, the authors identified a cubic pattern.

3.2.9 | Environmental risk domain

Only one study included risk attitudes in an environmental context. In the first study of Bonem et al. (2015), no age differences became evident. The authors also addressed a risk domain labelled ”other,” which included criminal and driving-related behavior. As in the environmental domain, no age differences regarding risk attitudes occurred.

Table 2 presents the effect sizes for each study with respect to the relationship between risk attitudes and age by domain. Figure 1 provides a summary of the effect directions for this relationship. Note that this plot differentiates between regression/correlation coefficients and age group comparisons because results are presented differently in the studies comparing age groups.

3.3 | Quality assessment

Two independent reviewers assessed the quality of the studies and reached agreement where assessments differed. All studies included in this review were of decent quality. Especially study background and objective, design, setting, main variables of interest, main results and the interpretation of key results were discussed in detail. Still, statistical methods could have been reported more thoroughly. Also, most studies would have benefited from more rigorous sensitivity analyses to underline the robustness of the study results. In addition, the reporting and handling of missing data as well as possible biases should have been clarified in several studies. An overview of all items and the assessment of each study are available upon request.

4 | DISCUSSION

Based on the presented evidence, risk attitudes seem to decrease with increasing age. This relationship is stable across different self-reported measurements for risk attitudes and comparable age groups. In this regard, two aspects have to be emphasized. First, the type of relationship between risk attitudes and aging varies, showing mostly linear and quadratic patterns across the lifespan. When quadratic patterns have been identified, a similar development of risk attitudes becomes apparent throughout the studies. The turning point of the relationship seems to be in early to late middle age. For example, Dohmen et al. (2017) found an approximately linear decrease until the age of 65 with a flatter slope hereafter. Schurer (2015) and Josef et al. (2016) identified decreasing risk attitudes until the age of 45 and 40 to 60, respectively, with changing slopes hereafter. Although, the presented evidence showed both steeper and flatter slopes after this age, risk attitudes still decreased across all age groups.

In addition, there do not seem to be systematic differences between cross-sectional and longitudinal analyses regarding the results. Except for the study by Josef et al. (2016), which found no relationship between aging and risk attitudes in the financial, health, and social domain, and a positive one in the recreational and career domain, all longitudinal analyses suggest a negative relationship between aging and risk attitudes. In the cross-sectional analyses, there is slightly more variation in that few studies found no association between aging and risk attitudes for single domains. However, this could result from the fact that the vast majority of included studies was cross-sectional analyses.

Apart from these observations, risk attitudes seem to differ with risk domains as emphasized by previous research. The assessed domains could be categorized into two clusters. The first cluster includes domains that can directly threaten physical and mental well-being, that is, financial, health, environmental, driving, and sports/leisure risk-taking. The second cluster refers more to interpersonal risk-taking and includes the domains of social, ethical, recreational, and career/occupational risk-taking.[4] This classification does not dismiss the fact that interpersonal risk-taking like social isolation can indirectly affect well-being as well.

Except for the environmental domain, risk attitudes in the first cluster decrease with age. This is in line with the common conception that individuals become more cautious with age (e.g., Jianakoplos & Bernasek, 2006). The missing effects in the environmental domain might result from the included items. These describe very extreme risks such as “being exposed to nuclear waste” or “getting caught in a natural disaster” (Bonem et al., 2015). It is possible that young and old adults rate the likelihood of taking these risks equally low. The

[4]General risk attitudes could be assigned to both clusters.

consistently low ratings across all age groups support this interpretation. In the second cluster, the results are more inconsistent which may be in part attributable to the low number of studies evaluating these domains. Especially in the social domain, the relationship between risk attitudes and aging seems less clear. Studies find both positive and negative as well as no effects. These findings reflect in results from previous research. Although older adults prefer familiar partners for social interactions (Fredrickson & Carstensen, 1990) hinting at lower social risk-taking in advanced age, older adults do not differ from younger adults in the amount of money they distribute to an unknown partner in the Dictator game (Roalf et al., 2012).

As previously discussed, the investigated relationship is characterized by diverging results between the measures used to elicit risk attitudes. While this review found mostly decreasing risk attitudes across the lifespan, studies with risk attitudes elicited by behavioral measures found different results.

This huge heterogeneity in the evidence might be attributable to several factors. First, as outlined before, behavioral measures seem to have lower convergent validity (Frey et al., 2017) and thus limited construct validity. Lönnqvist et al. (2015) found supporting evidence. It seems like there is more consensus within and across domains for self-reported risk attitudes and their association with age as the studies in this review mostly show a negative age-risk relationship (see also Frey et al., 2017).

However, self-reported measures could still address different aspects of risky decision making. A large difference regarding the conceptualization of risk attitudes exists between the DOSPERT scale and both general and domain-specific one-item risk questions. The DOSPERT assesses risk attitudes by asking participants to rate their likelihood for engaging in a certain domain-specific behavior (e.g., "co-signing a new car loan for a friend" or "frequent binge drinking", Weber et al., 2002). The general and domain-specific SOEP questions consist of one item, respectively, asking, for example, "How do you see yourself: Are you generally a person who is willing to take risks or do you try to avoid taking risks?" (Dohmen et al., 2011).[5] While addressing a certain risk behavior is more concrete, each behavior might still be characterized by varying levels of ambiguity (Rolison & Pachur, 2017). On the other hand, asking for a direct indication of risk attitudes might evoke different interpretations as to which behavior is related to certain domains.[6]

Second, previous literature has identified a number of factors which relate to both risk attitudes and aging or affect their relationship and might thus influence the heterogeneity of study results. Cognitive abilities decrease with aging (Li, Lindenberger, & Sikström, 2001) and are associated with risk attitudes (Burks, Carpenter, Goette, & Rustichini, 2009; Dohmen, Falk, Huffman, & Sunde, 2010; Oechssler, Roider, & Schmitz, 2009). In addition, memory-, verbal-, and numeracy-related tasks are found to affect the relationship between aging and risk attitudes (e.g., Bonsang & Dohmen, 2015; Henninger, Madden, & Huettel, 2010). Inconsistencies regarding age-related differences in risk attitudes might thus be related to individual variation in cognitive abilities. Recent evidence also suggests that age-related decline in cognitive abilities differs between birth cohorts (Hülür, Ram, Willis, Schaie, & Gerstorf, 2019). Thus, when assessing the relationship between age and risk attitudes, not only cognitive abilities but also their level in different birth cohorts has to be considered (also see discussion on shocks below).

Another important consideration associated with cognitive abilities is task ambiguity. As described before, a myriad of tasks exists to elicit risk attitudes. Within these tasks, some incorporate more ambiguity than others. For example, lottery tasks often include the choice between a certain (monetary) outcome and a risky gamble providing specific probabilities for the events of gain and loss. In this case, outcome magnitudes and probabilities are given and hence ambiguity is low. Other tasks involve higher ambiguity levels. Mata et al. (2011) define these tasks as "learning tasks" which require respondents to learn outcome probabilities from experience. Ambiguous tasks require more cognitive abilities than unambiguous ones (Rolison & Pachur, 2017). Based on the relation between ambiguity and cognitive abilities, a factor related to both risk attitudes and aging, it seems necessary to account for task ambiguity. In addition, task ambiguity has been shown to lower the association between self-reported and behavioral measures (Rolison & Pachur, 2017). This suggests that ambiguity could be in part responsible for differences between self-reported and behavioral measures of the age-risk relationship. Relating to task ambiguity, option complexity could play a role as well. Zilker, Hertwig, and Pachur (2020) showed that age differences in risk attitudes disappeared when the complexity of a safe option (vs. a risky one) was increased.

As a third factor, shocks that affect risk attitudes or the relationship between those and aging should be taken into account. First, macroeconomic shocks should be considered. As shown in this review, previous studies found a different relationship between risk attitudes and aging when controlling for period effects like the financial crisis or periods of market stability (e.g., Dohmen et al., 2017; Jianakoplos & Bernasek, 2006). Also, some birth cohorts might have higher levels of risk attitudes from the start. Studies which include a wide range of birth cohorts might thus be prone to show more diverging risk attitudes. Another type of shocks are health shocks. Decker and Schmitz (2016) show that health shocks (i.e., loss in grip strength, drop in self-assessed health, or onset of severe health condition) are associated with a long-term reduction in risk attitudes. Concluding from this research, heterogeneous study results could partly stem from heterogeneous health states of study participants.

In sum, this evidence calls for a number of aspects that should be examined in future research to understand the relationship between risk attitudes and aging independently from the type of measurement. First, clear-cut definitions as to which aspects of risky decision making are measured with the different approaches are indispensable. Bringing structure into the risk construct might clarify the cause of differences found for the age-risk relationship. In addition, potential

[5]The exact German wording is: "Sind Sie im Allgemeinen ein risikobereiter Mensch oder versuchen Sie, Risiken zu vermeiden?." All risk questions can be viewed online at https://www.diw.de/en/soep

[6]See Arslan et al. (2020) for an investigation of people's considerations when answering the general risk taking question of the SOEP.

confounders like cognitive abilities or health and macroeconomic shocks have to be identified and included as controls in future studies.

It has to be mentioned though that some of these factors discussed here have not been explicitly discussed in the included studies but represent aspects that are frequently debated with respect to age and risk attitudes.

This review has some limitations. Although the diversity in study designs strengthens the result of decreasing risk attitudes across the lifespan, this heterogeneity restricted the data synthesis to a narrative form. Thus, it was impossible to calculate an overall effect size within the investigated relationship. Additionally, only few studies assessed cohort or period effects. This made it difficult to derive conclusive evidence whether the relationship between risk attitudes and age is influenced by being born in another birth cohort or experiencing macroeconomic shocks. This issue should be addressed in future research. Also, it should be mentioned that the reviewed studies only consider chronological age. As elders of the same chronological age often show heterogeneous health states, another indicator of aging—biological age—has been proposed (Jylhävä, Pedersen, & Hägg, 2017). Future research could assess potential differences in the development of risk attitudes across chronological and biological age.

A last remark refers to the topic of causality. No conclusion can be drawn regarding a causal effect of age on risk attitudes. It is likely that changes related to aging drive differences in risk attitudes across the life span. Such changes do not only involve cognitive abilities (see discussion above) but also changes in physical or sensory abilities. Income-related changes after retirement might affect an individual's focus and risk attitudes in old age as well. Thus, it is possible to relate differences in risk attitudes to age but the causality behind this relationship remains unclear.

Apart from the limitations and indications for future research, this review has some implications for policy, especially in health and health care. For example, shared decision making in health care includes patients in the treatment decision process. Healthcare providers could consider or suggest more conservative treatment options for elderly patients and address other challenges for elders in shared decision making (see for a discussion Jansen et al., 2016). In addition, treatments could be tailored to any age group keeping in mind their respective level of risk attitudes. Furthermore, preventive measures could counteract inappropriate cautiousness in older age. Attempts have even been made to expand the DOSPERT by a medical domain to address self-reported risk attitudes regarding health care activities (Hanoch et al., 2018; Rosman, Garcia, Lee, Butler, & Schwartz, 2013).

5 | CONCLUSION

This review presents evidence for an overall negative relationship between self-reported risk attitudes and aging. The identified relationship is particularly evident in the general, financial, and health risk domain, whereas results are more inconsistent especially in the social risk domain. This provides evidence for the common conception that cautiousness increases with age.

It has to be noted though that no conclusion can be draw regarding a causal effect of age on risk attitudes. It is even more likely that changes related to aging are responsible for differences in risk attitudes across the life span.

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