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COGNITIVE SCIENCE
A Multidisciplinary Journal

Cognitive Science 47 (2023) e13345
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ISSN: 1551-6709 online
DOI: 10.1111/cogs.13345

Age-Related Differences in Moral Judgment: The Role of Probability Judgments

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Received 17 January 2022; received in revised form 25 July 2023; accepted 6 September 2023

Abstract

Research suggests that moral evaluations change during adulthood. Older adults (75+) tend to judge accidentally harmful acts more severely than younger adults do, and this age-related difference is in part due to the greater negligence older adults attribute to the accidental harmdoers. Across two studies ($N = 254$), we find support for this claim and report the novel discovery that older adults' increased attribution of negligence, in turn, is associated with a higher perceived likelihood that the accident would occur. We propose that, because older adults perceive accidents as more likely than younger adults do, they condemn the agents and their actions more and even infer that the agents' omission to exercise due care is intentional. These findings refine our understanding of the cognitive processes underpinning moral judgment in older adulthood and highlight the role of subjective probability judgments in negligence attribution.

Keywords: Moral judgment; Aging; Probability; Outcome bias; Negligence; Intentionality

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1. Introduction

As you browse the morning news, you read about a barista who accidentally served a dangerously hot cup of take-out coffee to a client who spilled it and suffered severe burns. Intuitively you would think that your evaluation of how morally wrong or negligent the barista's action was is independent of whether you judge this incident in your twenties or seventies. Surprisingly, studies demonstrate that this is not the case and moral evaluations of accidental harm can change during adulthood. Older adults tend to condemn accidentally harmful acts more than younger adults (Margoni, Geipel, Hadjichristidis, & Surian, 2018; Moran, Jolly, & Mitchell, 2012), and tend to judge the accidental harmdoer as more negligent (Margoni, Geipel, Hadjichristidis, & Surian, 2019; but see also Margoni, Cho, & Gutchess, 2023).

This study tests the psychological processes that underpin adult age-related differences in moral judgments of accidental harm. Older adulthood is characterized by a tendency to weigh outcome information more than mental state information, and in particular intentions (Margoni et al., 2018, 2019), whereas younger adulthood is characterized by the reverse tendency (Cushman, 2008; Monroe & Malle, 2017). Older adults tend to morally condemn accidentally harmful acts, presumably due to the harm that the agent's action caused, whereas younger adults judge such acts more leniently, likely due to the absence of a bad intention. This "outcome bias" in older adulthood has also been demonstrated in a financial task (a modified version of the ultimatum game) where participants could accept or reject low offers that were either intentional or unintentional (Cho, Song, Kim, & Sul, 2020; Margoni, Geipel, Hadjichristidis, & Surian, 2021). Older adults tended to reject low offers irrespective of whether they were intentional or not, whereas younger adults were significantly more accepting of the unintentional low offers.

Research has demonstrated that older adults' higher tendency to morally condemn accidentally harmful acts is associated with mental state attributions, and namely, a spontaneous inference that the agent was careless (Margoni et al., 2019). Consider the following scenario: Chloe works at a dog pound and unintentionally sells a rabid dog to a lady. Chloe did not inspect the dog, but her colleagues informed her that the dogs were healthy. Chloe's action caused harm as the dog bit the new owner. Margoni et al. (2019) found that older adults (75+ years) condemned Chloe's action to sell the dog more than younger adults did (18–36 years), and their increased condemnation was explained by an enhanced tendency to rate that Chloe was aware of the possible risks and acted without the necessary caution.

The present study takes a step further and examines the unique role of four mental state attributions in explaining age-related differences in accidental harm: *negligence* (acting without knowing that harm is probable, but one should have known this); *recklessness* (acting notwithstanding one knows that harm is probable); acting *knowingly* (acting notwithstanding one believes that harm is certain); and *intentionality* (acting with the intent of causing harm). Note that these mental states lie in a continuum from the least culpable one, acting negligently, to the most culpable one, acting with the intent to harm.

To foreshadow the results, evaluations of recklessness, acting knowingly, and intentionality were highly intercorrelated. Hence, besides negligence, we focused on intentionality, the most culpable mental state. We considered the possibility that older adults might spontaneously infer a bad intention from the fact that the agent was causally responsible for the bad outcome

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(see Malle, 2021). Regarding Chloe, older adults might condemn her more thinking that her decision included the willful omission to inspect the dogs. That is, they might assume that Chloe took an intentional shortcut and thus intentionally caused harm.

Furthermore, this study examines a possible precursor of adult age-related differences in mental state attributions (negligence, recklessness, acting knowingly, and intentionality), and thus in moral judgment, namely, age-related differences in how susceptible one is to the *hindsight bias*. The hindsight bias stands for people's tendency to overestimate their ability to have foreseen an outcome once the outcome is known, or an increased tendency to view the outcome as inevitable once it has occurred (Bernstein, Erdfelder, Meltzoff, Peria, & Loftus, 2011; Kneer & Machery, 2019). Regarding Chloe, older adults might be more likely to assume that the harmful outcome was foreseeable, or even inevitable, once they learn that it occurred and this may lead them to condemn Chloe's action more; Chloe should have done more to prevent the harm (Bayen, Erdfelder, Bearden, & Lozito, 2006).

Our hypothesis concerning the hindsight bias is motivated by two lines of research. First, moral evaluations are harsher toward actions whose negative outcomes are known as opposed to uncertain (moral hindsight; Fleischhut, Meder, & Gigerenzer, 2017). Second, older adults are more prone to the hindsight bias in numerical judgments than are younger adults (Bernstein et al., 2011; Groß & Pachur, 2019; Pohl, Bayen, Arnold, Auer, & Martin, 2018). However, it is unclear whether an increased hindsight bias in older adulthood explains age-related differences in moral judgments. Here, we aim to fill this gap.

1.1. The present research

Study 1 tested 40 younger (19–39 years) and 40 older adults (75–100 years) using accidental harm scenarios (Margoni et al., 2018, 2019; Young, Scholz, & Saxe, 2011). Study 2 replicated the findings with a different and larger sample of 91 older (75–95 years) and 83 younger adults (19–35 years). Besides asking participants to evaluate the moral wrongness and punishability of the actions, we also measured the extent to which they agreed that: (1) the agent should have believed that there was a high probability that an accident would occur (*negligence*); (2) the agent believed that there was a high probability that an accident would occur (*recklessness*); (3) the agent believed that an accident would occur (acted *knowingly*); and (4) the agent had the intention to cause the accident (*intentionality*).

To examine whether age-related differences in moral evaluations of accidental harm are associated with differences in the hindsight bias, following previous research (Groß & Bayen, 2022), we asked participants to estimate the probability that the accident would occur *before* and *after* presenting them the outcome. We quantified the hindsight bias as the ratio: $[(Prob_{After} - Prob_{Before}) / (Prob_{Before})]$, that is, as a percentage change from the initial before-outcome probability.

1.2. Predictions

First, we expected to replicate previous findings showing that older adults condemn accidental harm more than younger adults. Second, based on previous work showing the centrality of negligence in moral evaluations of accidental harm (Nobes & Martin, 2021; see also Nobes, Panagiotaki, & Martin, 2023), we predicted that this effect would be related to older

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adults attributing greater negligence to the harmdoers, and explored whether these attributions extend to more culpable mental states (recklessness, acting knowingly, and intentionality). Third, based on prior research, we predicted that older adults would exhibit the hindsight bias more than younger adults, and tested whether older adults would deem the accidental harm as more likely to occur even before the outcome was known. Fourth, we tested whether age-related differences in moral judgment are associated with age-related differences in the hindsight bias that, in turn, are the precursor of age-related differences in negligence, recklessness, acting knowingly, and intentionality attributions.

Regarding the fourth hypothesis, we found no evidence for age-related differences in hindsight bias but an age-related difference in probability judgment: older adults judged the probability of the accident as more likely to occur both before and after learning the outcome. This result is in line with work suggesting greater risk aversion in old age (e.g., Mather et al., 2012; Mikels & Reed, 2009; Zilker, Hertwig, & Pachur, 2020). Furthermore, because older adults believe that an accident is more likely to occur, they might attribute greater negligence to the harmdoer for failing to consider it, and might even assume that the omission was intentional. Therefore, in the path analyses, we used probability judgment as the precursor of mental state attributions rather than hindsight bias.

2. Study 1

2.1. Methods

The data and Supplementary Material are available on the Open Science Framework, see https://osf.io/8hac5/ (OSF, 2021). The research was approved by the Ethics Committee of the University of Trento ("Decision making and moral judgment in old age" #2019-013).

2.1.1. Power analysis

We defined a mixed 2 (Age group: younger, older) × 2 (Scenario: accidental, neutral) design with age as the between-participant factor and scenario as the within-participant factor using the *Superpower* approach (Lakens & Caldwell, 2021). We assumed that older participants would judge accidental harms more severely ($M = 7.67$, $SD = 2.95$, $n = 30$) than younger participants ($M = 2.17$, $SD = 2.79$, $n = 30$), while we expected no significant differences for the neutral scenarios between older ($M = 2.34$, $SD = 3.61$) and younger participants ($M = 1.03$, $SD = 2.27$; all means and standard deviations were based on the results of Margoni et al., 2018). We set the correlation to $r = .13$ between conditions. Using 10,000 simulations ($\alpha = .005$), the analysis suggested a minimum of 40 participants per group ($N = 80$) to achieve 99.6% power for a main effect of age ($\eta_p{}^2 = 0.32$) and 40 per group to achieve 99.9% power for the Age × Scenario interaction ($\eta_p{}^2 = 0.38$). Thus, the minimum total target sample size was 80 participants.

2.1.2. Participants

We recruited 80 participants, 40 older adults ($M_{Age} = 86.58$ years, $SD_{Age} = 6.55$, age range: 75–100, 30 female) and 40 younger adults ($M_{Age} = 24.38$ years, $SD_{Age} = 5.21$, age range:

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Table 1
Measures used in the present study

Type of measure	*Wording*[a]
$Prob_{Before}$(Accident)	How high is the probability that there will be an accident [as an example we presented the harmful outcome of the associated accidental harm story]?
$Prob_{After}$(Accident)	According to your opinion, how high was the probability of an accident?
Moral wrongness	How bad, morally wrong was [the agent's] action?
Punishment	How much should [the agent's] action be punished?
Negligence	How much should [the agent] have believed that there was a high probability of an accident?
Recklessness	How much did [the agent] believe that there was a high probability of an accident?
Acted knowingly	How much did [the agent] believe that an accident would occur?
Intentionality	How much did [the agent] have the intention to cause an accident?

Notes: The $Prob_{Before}$(Accident) and $Prob_{After}$(Accident) questions used a 0–100% scale ranging from 0 = *Not at all probable* to 100 = *Certain to occur*, whereas the remaining questions used an 11-point scale ranging from 0 = *Not at all*, 5 = *Somewhat*, to 10 = *Very much*.

[a]An anonymous reviewer correctly pointed out that accidents do not always result in harm and are by definition unintentional. Therefore, in our questions, we could have beneficially substituted the word "accident" with the word "harm."

19–39, 25 female). Older participants reported fewer years of school education than younger participants ($M = 7.23$, $SD = 3.45$, and $M = 14.05$, $SD = 1.89$, respectively), but we did not find evidence that education significantly predicts moral wrongness or probability judgments (full analyses are available in the Supplementary Material). The older adults were recruited through local residential communities, whereas the younger adults through fliers posted at the University of Trento, Italy. Both samples were recruited from the same central-northern region in Italy. We screened older participants for possible cognitive impairment with the Mini-Mental Status Examination (Folstein, 1975). All participants scored between 24 and 30 (possible score range between 0 and 30), which indicates no cognitive impairment.

2.1.3. Materials and procedure

2.1.3.1. Stories without outcome information: Participants first saw the three stories they later evaluated in the moral judgment task but without the outcome information. They were asked to judge the probability that an accident would occur ($Prob_{Before}$[Accident]; see Table 1).

2.1.3.2. Moral judgment task: Participants were then presented with three *accidental harm stories*, like the story of Chloe, where the actions of agents with neutral intentions caused harm, and with three *neutral stories*, which were identical to the accidental harm stories with the exception that their outcome was neutral (e.g., in the case of Chloe, the dog was healthy and turned out to be a good pet). For the complete battery, see the Supplementary Material. Following each story, participants were asked seven questions about: moral

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wrongness, punishment, negligence, recklessness, acting knowingly, intentionality, and the probability of an accident (see Table 1).

Overall, participants were presented with nine stories: three without outcome information, three accidental harm stories, and three neutral stories. Each type was presented as a separate block, and the blocks followed the order: (1) stories without outcome; (2) accidental harm stories; and (3) neutral stories. Within each block, the three stories were presented in a randomized order, and the order of the first three questions (moral wrongness, punishment, and negligence) was counterbalanced across participants using a Latin square design. Between blocks (1) and (2), participants performed an executive functioning task (*Stroop Color Word Test*, SCWT; Stroop, 1935), and between blocks (2) and (3), they performed a theory of mind task (Strange Stories task; Happé, 1994; Lecce et al., 2019). For details, see the Supplementary Material.

2.2. Results

Here, we focus on the main findings. Exploratory analyses are available in the Supplementary Material.

2.2.1. Age-related differences in moral wrongness, punishment, and mens rea judgments (negligence, recklessness, acting knowingly, and intentionality)

We replicated the age differences of prior studies (Margoni et al., 2018, 2019), and extended them to additional culpable mental states. Older adults judged accidental harm as more morally wrong and punishable than did younger adults, and judged the accidental harmdoers as more negligent, reckless, knowledgeable of the risk, and intentional to cause harm. However, we found no evidence of age-related difference for neutral cases (see Fig. 1, Table 2, and the Supplementary Material for details).

2.2.2. Probability judgments and hindsight bias by age group

2.2.2.1. Probability judgments: *Before* reading the outcome of the scenario, older adults judged the accident as more likely to occur ($M = 0.53$, 95% CI [0.12, 0.93]) than younger adults ($M = 0.37$, 95% CI [–0.04, 0.77]), $F(1, 77.2) = 22.6$, $p < .001$. Older adults also judged the accident as more likely to occur *after* having learned about the outcome ($M = 0.79$, 95% CI [0.62, 0.95) than younger adults ($M = 0.51$, 95% CI [0.35, 0.68]), $t(152) = -7.36$, $p_{bonf} < .001$, $d = 0.67$. The change was in the opposite direction for neutral cases ($M_{Older} = 0.18$, 95% CI [0.02, 0.34]; $M_{Younger} = 0.34$, 95% CI [0.17, 0.50]), $t(152) = 4.27$, $p_{bonf} < .001$, $d = 0.39$. The Age group × Scenario type interaction was significant, $F(1, 395.2) = 114.50$, $p < .001$. Table 3 shows all results.

2.2.2.2. Hindsight bias: We calculated the *hindsight bias* using the following formula: $[(Prob_{After} - Prob_{Before}) / Prob_{Before}]$. The hindsight score of older adults for accidental harm was 48% ([78.70–53.24]/53.24), whereas that for younger adults was 40% ([51.40–36.60]/36.60). Otherwise stated, after learning about the accident, older adults increased their initial probability by 48%, whereas younger adults increased their respective initial proba-

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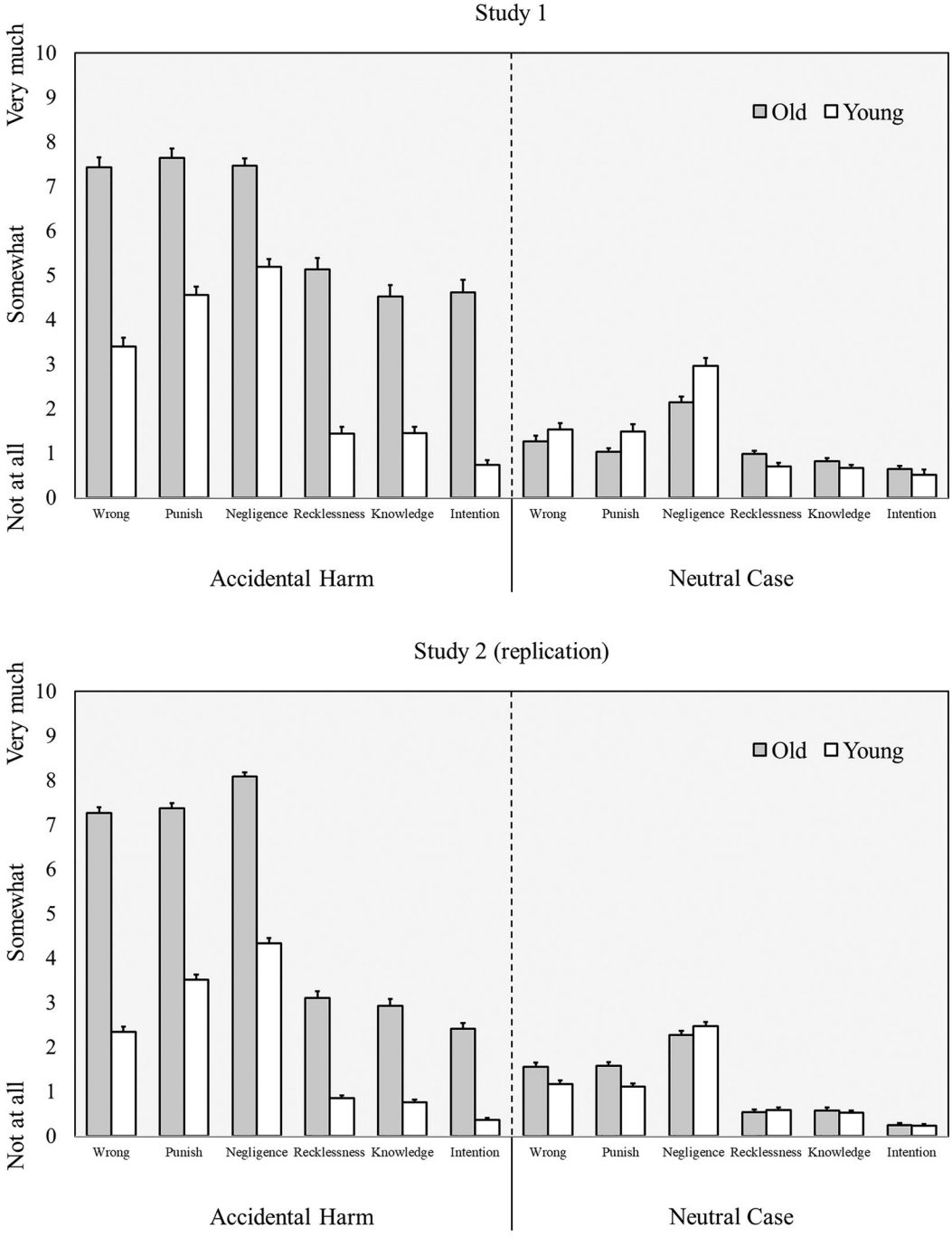

Fig 1. Mean moral wrongness, punishment, negligence, recklessness, acting knowingly, and intentionality ratings by age group and scenario type (for Studies 1 and 2).

Note. Error bars indicate the standard error of the mean. All scales ranged from 0 = not at all to 10 = very much.

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Table 2
Regression analyses: predicting dependent variables by age group and type of scenario

			95% CI				
Fixed effect	Estimate	*SE*	*LL*	*UL*	*Df*	*F*	*p*
Moral wrongness							
Intercept	3.36	0.40	2.58	4.14	2.88	8.47	.004
Age group	1.78	0.21	1.02	2.54	78.03	4.57	<.001
Scenario type	–4.11	0.21	–4.53	–3.70	394.24	–19.39	<.001
Age × Scenario	–4.50	0.42	–5.34	–3.67	394.25	–10.62	<.001
Punishment							
Intercept	3.68	0.48	2.75	4.61	2.52	3.43	<.001
Age group	1.30	0.38	0.56	2.04	78.09	3.43	<.001
Scenario type	–4.84	0.21	–5.26	–4.42	393.42	–22.69	<.001
Age × Scenario	–3.52	0.43	–4.35	–2.68	393.42	–8.24	<.001
Negligence							
Intercept	4.44	0.61	3.25	5.64	2.32	7.31	.012
Age group	0.73	0.38	–0.02	1.48	77.99	1.91	.060
Scenario type	–3.77	0.20	–4.16	–3.38	395.08	–18.86	<.001
Age × Scenario	–3.09	0.40	–3.88	–2.31	395.08	–7.73	<.001
Recklessness							
Intercept	2.06	0.26	1.56	2.57	4.99	7.97	<.001
Age group	1.98	0.36	1.27	2.69	78.05	5.46	<.001
Scenario type	–2.45	0.18	–2.79	–2.10	395.11	–13.71	<.001
Age × Scenario	–3.43	0.36	–4.13	–2.73	395.11	–9.61	<.001
Acted knowingly							
Intercept	1.87	0.23	1.41	2.33	5.22	8.00	<.001
Age group	1.61	0.34	0.95	2.27	78.02	4.76	<.001
Scenario type	–2.26	0.17	–2.59	–1.92	395.11	–13.19	<.001
Age × Scenario	–2.92	0.34	–3.59	–2.25	395.11	–8.54	<.001
Intentionality							
Intercept	1.63	0.23	1.17	2.09	6.31	6.99	<.001
Age group	2.00	0.36	1.29	2.72	78.08	5.51	<.001
Scenario type	–2.10	0.19	–2.46	–1.73	395.16	–11.14	<.001
Age × Scenario	–3.74	0.38	–4.48	–3.00	395.16	–9.95	<.001

Notes: We conducted mixed-effects models with participants and scenario (dog, jellyfish, zoo) as random intercepts and age group (younger, older) and item type (accidental, neutral) as fixed effects. Response scale: 0 = Not at all; 5 = Somewhat; 10 = Very much. Age group: 0 = younger; 1 = older. Scenario type: 0 = accidental; 1 = neutral.

Abbreviations: CI, confidence interval; LL, lower limit; UL, upper limit.

bility by 40%, $z = 0.72$, $p = .472$. Thus, we did not find evidence that the hindsight bias in the two age groups differed. Therefore, in the following path models instead of including the hindsight bias as a mediator, we included probability judgment ($Prob_{After}$), which was higher in older than in younger adults.

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Table 3
Statistics for probability judgments of accidental harm and neutral cases

			95% CI				
Fixed effect	Estimate	*SE*	*LL*	*UL*	*Df*	*F*	*p*
Probability before							
Intercept	0.45	0.10	0.25	0.64	2.00	4.53	.045
Age group	0.16	0.03	0.09	0.22	77.19	4.76	<.001
Probability after							
Intercept	0.45	0.05	0.36	0.55	2.26	9.36	.007
Age group	0.06	0.03	–0.00	0.12	78.09	1.85	.069
Scenario type	–0.39	0.02	–0.43	–0.35	395.24	–19.41	<.001
Age × Type	–0.43	0.04	–0.51	–0.35	395.24	–10.70	<.001

Note. We conducted a linear mixed-effects model using age group and scenario type (accidental, neutral) as fixed effects and participants and scenarios (1–3) as random intercepts.

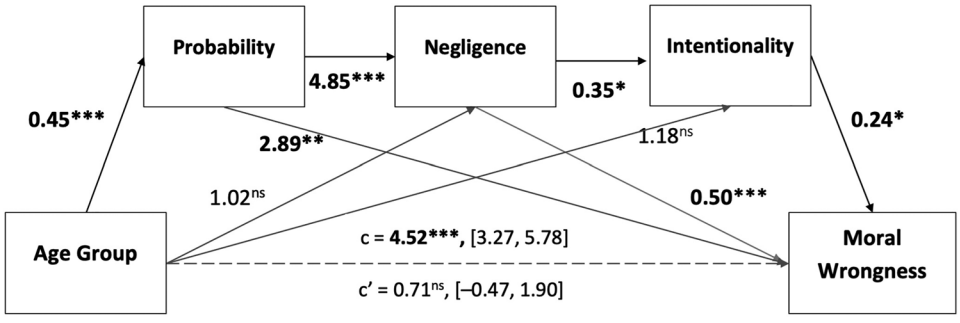

Fig 2. Mediation model examining the serial path from age group to probability to negligence to intentionality to moral wrongness.

Note. Mediation coefficients are unstandardized, 95% confidence intervals are in brackets. ***p<.001; **p<.01; *p<.05.

2.2.3. Examining the path from age group to moral judgment through probability to negligence to intentionality

We tested the serial path model from age group to probability to negligence to intentionality to moral judgment. The outcome variable was moral wrongness (difference score: mean difference in moral wrongness between accidental harm and neutral cases). The predictor variable was age group (0 = younger, 1 = older) and the mediators were probability, negligence, and intentionality (difference scores between accidental and neutral cases). Recklessness and acting knowingly were omitted from the model to increase its accuracy and stability because these variables were strongly correlated with intentionality (Recklessness: $r[78] = .859$, $p<.001$, Acting knowingly: $r[78] = .916$, $p<.001$) and their inclusion caused a multicollinearity problem (Variance Inflation Factor, $VIF_{Recklessness} = 6.43$; $VIF_{Acting\ Knowingly} = 8.98$). We chose to focus on intentionality as it is the most culpable mental state. Fig. 2 illustrates the model.

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The indirect effect was significant ($b = 3.81$, 95% CI [2.65, 5.08]). The simple effect of age group to wrongness through probability alone was significant ($b = 1.30$, 95% CI [0.23, 2.52]), and so was the effect of age group to wrongness through intentionality ($b = 0.29$, 95% [0.01, 0.70]), but not the indirect effect of age group to wrongness through negligence ($b = 0.51$, 95% CI [–0.14, 1.35]). Importantly, the serial effect (four-way interaction) from age group to probability to negligence to intentionality to moral wrongness was significant ($b = 0.19$, 95% CI [0.02, 0.47]), suggesting a serial mediation. The effect of age group on moral wrongness was significantly reduced (from $b = 4.52$, 95% CI [3.27, 5.78] to $b = 0.71$, 95% CI [–0.47, 1.90]) when controlling for probability, negligence, and intentionality. The serial mediation remained significant after controlling for theory of mind and executive functioning (serial effect: $b = 0.11$, 95% CI [0.03, 0.30], total effect: $b = 3.60$, 95% CI [2.32, 4.87]; direct effect: $b = 0.74$, 95% CI [–0.46, 1.94]).

2.3. Interim discussion

Study 1 replicated previous findings by showing that older adults judge accidentally harmful actions more severely than younger adults. Importantly, it revealed a novel factor underlying this effect: older adults' tendency to ascribe a higher probability that an accident would occur, both *before* and *after* learning about the outcome. This higher perceived probability led older adults to assign higher negligence attributions, which in turn led to greater intentionality attributions, with all paths leading to increased judgments of moral wrongness. Overall, our findings highlight the role of probability judgment in explaining age-related differences in moral judgment.

3. Study 2

Study 2 is a preregistered direct replication of Study 1 with a larger sample.

3.1. Methods

The study protocol, predictions, number of participants, exclusion criteria, and analysis plan were preregistered on aspredicted.org (https://aspredicted.org/fe6uc.pdf).

3.1.1. Power analysis

We estimated the minimum required sample size based on assumed effect sizes between small and medium for the "α" paths (age group to mediators) and the "β" paths (mediators to outcome) of our mediation models ($f = 0.26$, power = .80) using the percentile bootstrapping method (Fritz & MacKinnon, 2007). The analysis indicated a minimum total sample size of 162 participants.

3.1.2. Participants

We recruited 174 participants, 91 older adults ($M = 83.14$ years, $SD = 5.56$, age range: 75–95, 59% female) and 83 younger adults ($M = 22.04$ years, $SD = 2.72$, age range: 19–

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35, 64% female), in the same way as in Study 1. Older participants reported fewer years of school education than younger participants ($M = 7.81$, $SD = 3.49$, and $M = 14.37$, $SD = 1.71$, respectively), but we did not find evidence that education significantly predicts moral wrongness or probability judgments (full analyses can be found in the Supplementary Material). All older adults scored between 24 and 30 on the Mini-Mental Status Examination, which indicates no cognitive impairment.

3.1.3. Materials and procedure

The materials and procedure were identical to Study 1 except that we did not administer the executive function and theory of mind tasks to keep it short and facilitate participation.

3.2. Results

3.2.1. Age-related differences in moral wrongness, punishment, and mens rea judgments (negligence, recklessness, acting knowingly, and intentionality)

Replicating Study 1, compared to younger adults, older adults judged the agents' behavior leading to accidental harm as more morally wrong and punishable, and the agent as more negligent, reckless, knowingly causing harm, and intentionally causing harm. Furthermore, we did not find evidence of age-related difference for the neutral cases (see Fig. 1, Table 4, and the Supplementary Material for details).

3.2.2. Probability judgments and hindsight bias by age group

3.2.2.1. Probability judgments: *Before* being presented with the outcome of the scenario, older adults judged the accident as more likely to happen ($M = 0.46$, 95% CI [0.21, 0.72]) than did younger adults ($M = 0.32$, 95% CI [0.07, 0.57]), $F(1, 172) = 29.3$, $p < .001$. Older adults also judged that the accident was more likely to occur *after* having learned about the outcome ($M = 0.72$, 95% CI [0.54, 0.89) than did younger adults ($M = 0.45$, 95% CI [0.29, 0.62]), $t(281) = -9.65$, $p_{bonf} < .001$, $d = 1.47$. For neutral cases, we did not find evidence of an age difference ($M_{Older} = 0.25$, 95% CI [0.08, 0.42]; $M_{Younger} = 0.31$, 95% CI [0.14, 0.48]), $t(280) = 1.96$, $p_{bonf} = .303$, $d = 0.30$. The Age group × Scenario type interaction was significant, $F(1, 395.2) = 114.50$, $p < .001$. The results are presented in Table 5.

3.2.2.2. Hindsight bias: After learning that an accident occurred, older adults increased their initial probability by 54% ([71.78–46.18]/46.18), whereas younger adults increased it by 43% ([45.43–31.83]/31.83), $z = 1.45$, $p = .147$. As in Study 1, we found no significant age-related difference on hindsight bias. In the mediation models below, we focus on $Prob_{After}$ judgment.

3.2.3. Serial path from age group to moral judgment through probability to negligence to intentionality

As preregistered, we tested the serial path model from age group to probability to negligence to intentionality to moral judgment. The outcome variable was moral wrongness (difference score: mean moral wrongness of accidental harm cases minus mean moral wrongness

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Table 4
Regression analyses: predicting dependent variables by age group and type of scenario

Fixed effect	Estimate	*SE*	95% CI		*Df*	*F*	*p*
			LL	*UL*			
Moral wrongness							
Intercept	3.09	0.32	2.46	3.73	2.40	9.54	.006
Age group	2.64	0.23	2.19	3.10	172.09	11.42	<.001
Scenario type	–3.45	0.23	–3.70	–3.19	861.99	–26.45	<.001
Age × Scenario	–4.50	0.26	–5.01	–3.99	861.99	–17.25	<.001
Punishment							
Intercept	3.40	0.38	2.65	4.14	2.26	8.91	.008
Age group	2.16	0.23	1.72	2.61	172.17	9.54	<.001
Scenario type	–4.10	0.13	–4.35	–3.84	862.12	–31.66	<.001
Age × Scenario	–3.37	0.26	–3.88	–2.87	862.12	–13.03	<.001
Negligence							
Intercept	4.30	0.48	3.36	5.23	2.14	8.99	.010
Age group	1.77	0.22	1.33	2.20	172.24	7.99	<.001
Scenario type	–3.84	0.13	–4.10	–3.58	862.31	–28.80	<.001
Age × Scenario	–3.92	0.27	–4.44	–3.40	862.31	–14.70	<.001
Recklessness							
Intercept	1.28	0.15	0.98	1.57	4.59	8.50	<.001
Age group	1.11	0.21	0.69	1.52	171.53	5.25	<.001
Scenario type	0.65	0.12	0.42	0.88	861.36	5.57	<.001
Age × Scenario	1.00	0.23	0.54	1.46	861.36	4.29	<.001
Acted knowingly							
Intercept	1.20	0.12	0.97	1.44	10.41	10.04	<.001
Age group	1.11	0.21	0.71	1.44	10.41	10.04	<.001
Scenario type	–1.31	0.10	–1.50	–1.12	860.65	–13.33	<.001
Age × Scenario	–2.15	0.20	–2.53	–1.76	860.65	–10.92	<.001
Intentionality							
Intercept	0.82	0.11	0.59	1.04	6.94	7.17	<.001
Age group	1.04	0.18	0.69	1.39	171.28	5.82	<.001
Scenario type	–1.14	0.09	–1.32	–0.97	860.94	–13.14	<.001
Age × Scenario	–2.01	0.17	–2.35	–1.67	860.94	–11.55	<.001

Notes: We conducted linear mixed-effects models with age group (younger, older) and item type (accidental, control) as fixed effects and participants and items (dog, jellyfish, zoo) as random intercepts. Response scale: 0 = Not at all; 5 = Somewhat; 10 = Very much. Age group: 0 = younger; 1 = older. Scenario type: 0 = accidental; 1 = neutral.

Abbreviations: CI, confidence interval; LL, lower limit; UL, upper limit.

of neutral cases). The predictor was age group (0 = young, 1 = old) and the mediators were probability, negligence, and intentionality (all difference scores). As in Study 1, recklessness and acting knowingly were strongly correlated with intentionality (Recklessness: $r[171] = .882$, $p<.001$, Acting knowingly: $r[171] = .903$, $p<.001$) and their inclusion caused a multicollinearity problem ($VIF_{Recklessness} = 8.81$; $VIF_{Knowing} = 10.63$). Thus, we omitted these two variables from the model. Fig. 3 illustrates the model.

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Table 5
Statistics for probability judgments of accidental harm and neutral cases

			95% CI				
Fixed effect	Estimate	*SE*	*LL*	*UL*	*Df*	*F*	*p*
Probability before							
Intercept	0.39	0.06	0.26	0.52	2.09	6.04	.002
Age group	0.14	0.03	0.09	0.20	172.00	5.41	<.001
Probability after							
Intercept	0.43	0.05	0.34	0.53	2.18	9.18	.009
Age group	0.10	0.02	0.06	0.15	170.33	4.47	<.001
Scenario type	–0.31	0.01	–0.33	–0.28	860.24	–23.54	<.001
Age × Type	–0.31	0.03	–0.36	–0.26	860.24	–12.02	<.001

Note. We conducted a linear mixed-effects model with age group and scenario type as fixed factors and participants and items as random intercepts.

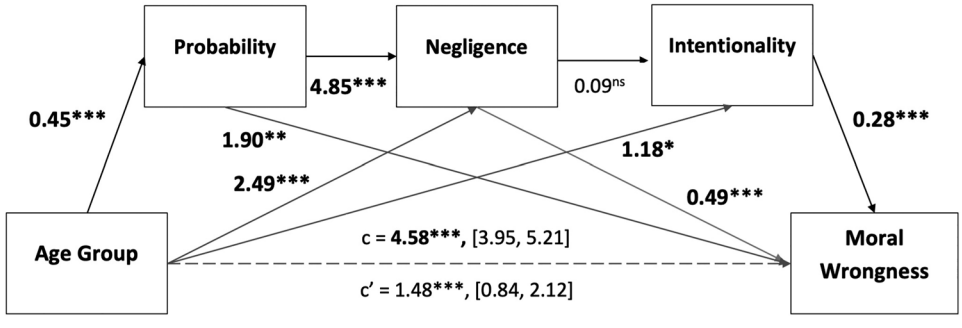

Fig 3. Mediation model examining the path from age group to probability to negligence to intentionality to moral wrongness.

Note. Mediation coefficients are unstandardized, 95% confidence intervals are in brackets. ***p<.001; **p<.01; *p<.05.

The indirect effect was significant (b = 3.11, 95% CI [2.58, 3.67]). The simple indirect effect of age group to wrongness through probability alone was significant (b = 0.61, 95% CI [0.23, 1.14]), and so was the effect of age group to wrongness through negligence alone (b = 1.21, 95% CI [0.73, 1.73]), and the effect of age group to wrongness through intentionality alone (b = 0.33, 95% CI [0.13, 0.66]). The serial effect of age group to probability to negligence to moral wrongness was also significant (b = 0.72, 95% CI [0.42, 1.06]). However, the serial effect from age to probability to negligence to intentionality to moral wrongness was not significant (b = 0.04, 95% CI [–0.04, 0.12]), suggesting no serial mediation (four-way interaction). The effect of age group to moral wrongness was reduced (but remained significant) once controlling for probability, negligence, and intentionality (from b = 4.58, 95% CI [3.95, 5.21] to b = 1.48, 95% CI [0.84, 2.12]).

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3.3. Interim discussion

Study 2 successfully replicated the main findings of Study 1. Older adults judged the accident as more probable than younger adults did, which, in turn, was related to an increased attribution of negligence to the agent, leading to a greater condemnation of their action. However, in contrast to Study 1, Study 2 did not support the link between attributions of negligence and attributions of intentionality.

4. General discussion

We found age-related differences in adult moral judgments of accidental harm. Overall, older adults judged accidental harms more harshly than younger adults, but we did not find evidence of age-related differences for the neutral scenarios. Our findings identify a new factor that contributes to the age-related effect on moral judgments of accidental harm: older adults' higher ascription of probability that the harm would occur. This increased probability leads to greater attributions of negligence (and sometimes intentionality), which, in turn, result in harsher moral judgments. In contrast to previous research (e.g., Bernstein et al., 2011), we found no evidence that age influences the hindsight bias.

The tendency of older adults to judge accidents as more likely compared to younger adults is still poorly understood. However, developmental criminology research indicates that criminal behavior and risk-taking tendencies increase during adolescence and decrease in old age, as evidenced by the "age-crime curve" effect (Moffitt, 1993; Shulman, Steinberg, & Piquero, 2013). This effect is believed to have deep evolutionary roots (Ellis et al., 2012). As people age, developmental and social factors lead them to become more risk averse, prompting a greater perception of potential threats and less willingness to engage in risky behavior. As a result, older adults may perceive negative outcomes and accidents more likely to occur.

Alternatively, it is possible that older adults' greater life experience leads them to estimate the likelihood of accidents more realistically than younger adults, and that the age difference in probability judgments results from an underattribution of negligence and bad intent in younger adults. Furthermore, additional factors, such as political attitudes, world views, and beliefs, might contribute to the age-related differences in probability judgments of accidental harm. For instance, on average, older cohorts are associated with more conservative attitudes than younger cohorts (Peterson, Smith, & Hibbing, 2020), which, in turn, are associated with more pessimistic views of human nature. Therefore, these differences between older and younger cohorts could account for the more "pessimistic" judgments of older adults or more "optimistic" judgments of younger adults.

In addition to uncovering age-related differences in probability judgment, our study also identified an association between these estimates and age-related differences in the ascription of negligence, intentionality, and moral condemnation. We theorized that probability differences led to differences in negligence and other culpable mental states, which ultimately influenced moral judgments (see also Kneer & Machery, 2019; Kneer & Skoczen, 2023). However, there exist alternative theories. For example, one theory proposes that moral judg-

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ment is inherently intuitive (e.g., people automatically judge moral wrongness based on how they feel), while the attribution of negligence and more culpable mental states is a post-hoc attempt to rationalize it (Alicke, 2000, 2014). Accordingly, negative outcomes and emotional processes directly trigger moral condemnation, which could prompt ascriptions of negligence and probability. To assess this alternative theory, we conducted additional path models (see Supplementary Material). Overall, our findings are also consistent with this theory. Thus, we cannot adjudicate between these alternative models.

4.1. Implications

One important component in criminal trials is proving *mens rea*; that the accused acted with a guilty mind. To the extent that older adults infer negligence and other culpable mental states based on the negative outcomes, they might deliver more guilty verdicts. Indeed, this is exactly what an analysis of several court cases found (Anwar, Bayer, & Hjalmarsson, 2014). Data from more than 700 felony trials in Florida showed that older jurors were significantly more likely to convict. Beyond the judicial system (Sommers, 2021), the present findings suggest that older adults' tendency to attribute a guilty mind to agents on the basis of negative outcomes may negatively impact their well-being. It might lead them to feel resentful in social interactions, such as interpreting a loved one's inability to attend a family gathering as negligent and even intentional, and thus to hold grudges.

4.2. Conclusion

Whereas most developmental research on moral judgment has focused on early human development, our study examines changes between early and late adulthood. We demonstrate that older adults perceive accidental harms as more likely to occur than their younger counterparts, attribute more negligence and intentionality to the agents, and condemn their actions more. These age-related differences could influence the perception of intent in legal cases and sway verdicts. These processes could also lead older adults to be more cautious in their daily lives than younger adults and to attribute more negligence and bad intent to others, which could ultimately affect their social relationships and psychological well-being.

Acknowledgments

We thank Silvia Dada, Francesca Bonazzi, Gaia Stefanelli, Luisa Cutrone, Tommaso Battaglia, and Susanna Mattiuz for assisting with data collection.

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