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Sunk-cost judgments across the child to adult lifespan

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Abstract

The sunk-cost effect (SCE) refers to the continuation of an activity after investing resources in the activity. Current developmental research on the SCE in childhood is mixed, but some researchers suggest that sunk-cost judgements decline with age after childhood. To better understand age differences in sunk-cost judgements across the lifespan, we conducted two experiments with the widest age range used in the literature thus far to examine the SCE across the lifespan, while using the same measures for all ages. Samples ranged from 2-97 years of age (Experiment 1: lab-based; $N = 682$; Experiment 2: community sample; $N = 378$). We found a similar pattern across both experiments: adults and adolescents consistently made sunk-cost judgements, but children did not. We also observed differences in age patterns between different sunk-cost measures, suggesting that researchers should consider how individuals of different ages might respond to different decision-making vignettes. Our findings suggest that children do not consistently make sunk-cost judgements like older children and adults.

Keywords: *sunk-cost effect, children, adults, adolescents*

Sunk-cost judgements across the child to adult lifespan

Continuing to pursue an activity after investing resources in it is called the sunk-cost effect (SCE; Arkes & Blumer, 1985). A review of the SCE across the lifespan proposes that (1) children are most susceptible to sunk-cost judgements; (2) ability to avoid sunk-cost judgements improves in adolescence and remains stable in adulthood; and (3) ability to avoid sunk-cost judgements increases in older adulthood (60+; Strough et al., 2011a). This developmental trajectory of sunk-cost judgements across the lifespan is based on conclusions from different studies that have used different measures to examine the SCE in different age groups across the lifespan. For instance, some researchers stress the difference between *utilization* (choice between two alternatives that differ by sunk-cost, or the use of a paid-for product) and *progress* measures (deciding whether to continue or abandon a project after initial investment; see Moon, 2001; Roth et al., 2015). Utilization measures tend to show a larger SCE, and progress measures do not show the SCE decreases with age (Roth et al., 2015). Moreover, there is variation in the operational definition of sunk-cost decisions across studies (e.g., difference between low/high-cost conditions, binary or categorical choice between two items/courses of action, likelihood to continue with the high-cost option, etc.).

Some researchers who have examined the SCE in childhood and adolescence claim that children as young as five make sunk-cost judgements (Baron et al., 1993; Klaczynski, 2001; Klaczynski & Cottrel, 2004; Morsanyi & Handley, 2008). Some researchers report that susceptibility to make sunk-cost judgements does not change from childhood to adolescence (adolescence referring to ~10-18; Baron et al., 1993; Morsanyi & Handley, 2008); others report that the ability to avoid sunk-cost judgements improves from childhood to adolescence, which continues into adulthood (Klaczynski, 2001; Klaczynski & Cottrel, 2004). This emerging ability

to avoid sunk-cost judgments from childhood to adolescence has been traditionally explained by cognitive development and dual processing theories which assert both implicit-intuitive and explicit-deliberate processes occur in parallel while people make decisions (Klaczynski & Cottrell, 2004; Strough, et al., 2011a; Strough et al., 2015). Implicit-intuitive processes are automatic and effortless and often rely on heuristics that lead to sunk-cost judgments (e.g., to not waste invested resources; Arkes, 1996; Arkes & Blumer, 1985). Explicit-deliberate processes are effortful and require the use of metacognitive processes which continue to develop through adolescence and adulthood and lead to more rational sunk-cost avoidant decisions (Klaczynski & Cottrell, 2004; Weil et al., 2013). According this this theoretical approach, children are most susceptible to the SCE because they rely on implicit sunk-cost rationale and become more resistant to sunk-cost decisions as they develop more deliberate decision-making abilities.

Alternatively, some argue that young children may not have developed the heuristics that cause sunk-cost errors, and that children do not consider previous investments in sunk-cost scenarios (Arkes and Ayton, 1999; Webley & Plaisier, 1998). Other researchers find young children between the ages of five and seven do recognize sunk costs (Jara-Ettinger et al., 2015; 2016; Pesowski et al., 2016) but do not systematically implement them in judgements about future behavior (Sehl et al., 2021; 2024a). Possible reasons for this include: (1) processes linked to expectations for rational behaviour; (2) not seeing previous investment as a waste; (3) discounting waste regret on future behavior; and (4) not seeing sunk costs as recoverable through continued investment (see Sehl et al., 2021; 2024a). Yet, children have been shown to make sunk-cost decisions and cite prior investments as the motivation behind their judgements (Baron et al., 1993; Morsanyi & Handley, 2008). Sehl and colleagues (2024b) found that 5-to-7-year-olds made sunk-cost judgements only if they were asked to reflect on the effort and emotion

related to sunk costs. Moreover, Klaczynski (2001) found that children as young as nine judge arguments against the SCE as superior to those for the SCE, but older adolescents are better able to implement these judgements in sunk-cost decisions. Therefore, there may be a complex developmental interplay between the understanding and implementation of reasoning for and against sunk costs.

More research has examined sunk-cost judgements in adulthood. Several studies find sunk-cost judgements are stable in adulthood, and decline in older adulthood (i.e., 60+; (Bruine de Bruin et al., 2007; Bruine de Bruin et al., 2012; Del Missier et al., 2013; Eberhardt et al., 2019; Huai et al., 2023; Strough et al., 2008, Strough, et al., 2011b; Parker et al., 2018; Roth et al., 2015). Yet, some research suggests that sunk-cost judgements remain stable throughout older adulthood (Del Missier et al., 2020). Table 1 summarizes the pertinent lifespan SCE studies.

Table 1

SCE Across the Lifespan: Literature Summary

Paper	**Sample size and ages (yrs)**	**Main findings**	**Measurement properties**
Sehl et al., (2021)	Study 1: 5-6; 22-72 (N = 177) Study 2: 5-6 (N = 60) Study 3: 6 (N = 31) Study 4: 6 (N = 34)	Adults but not children made sunk-cost judgments.	Studies 1, 2 & 3: Two third-person Utilization vignettes with effort sunk costs. Binary choice between high/low-cost items. Study 3: One third-person Utilization vignette with effort sunk cost. Binary choice between high/low-cost items.
Sehl et al., (2024a)	Study 3: 5-7; 21-72 (N = 309)	Adults but not children made sunk-cost judgments.	Study 3: Two third-person Utilization vignettes with effort sunk costs. Binary choice between high/low-cost items.
Sehl et al., (2024b)	5-7 (N = 180)	Children made sunk-cost judgments *if* they	Two third-person Utilization vignettes with effort sunk costs. Binary choice between high/low-cost items.

		reflected on emotion and effort related to sunk costs.	
Morsanyi & Handley (2008)	5-11 (N = 48)	No relation between age and sunk-cost judgments.	One pair of high/low sunk cost first-person Utilization-Progress vignettes with monetary sunk cost. Categorical choice for how much longer to use the product.
Baron et al., (1993)	Study 1: 7-15 (N = 103) Study 2: 5-11 (N = 63)	No relation between age and sunk-cost judgments. 50% of children 5 -11, and 27% of children 7-15 made sunk-cost judgements.	Study 1: One first-person Utilization vignette with monetary sunk cost. Categorical choice for preference between high/low-cost items. Study2: One first-person Utilization vignette with effort sunk cost. Binary choice between high/low-cost items. One first-person Utilization-Progress vignette with monetary sunk cost. Open ended response about decision.
Webley & Plaisier (1998)	5-6; 8-9; 11-12 (N = 60)	No relation between age and sunk-cost judgments.	One pair of low/high sunk cost first-person Progress vignettes with monetary sunk costs. Binary choice whether to continue or not.
Klaczynski & Cottrell (2004)	Study 1: 7-14 (N = 94) Study 2: 9;12;15 (N = 331)	Sunk-cost judgments decreased from age 8 to age 14. 15-year-olds were more likely to employ arguments to avoid sunk-cost judgements than 9- and 10-year-olds.	Study 1: One pair of high/low sunk cost first-person Utilization vignettes with monetary sunk costs. Binary choice between high/low-cost items. One pair of low/high sunk cost first-person progress vignettes with time/effort as sunk costs. Binary choice whether to continue or start over.
Klaczynski (2001)	11-25 (N = 90)	Participants 15+ were better able to ignore sunk costs than 11–14-year-olds.	One pair of low/high sunk cost first-person Utilization-Progress vignettes with monetary sunk costs. Categorical choice for how much longer to use the product.
Parker et al., (2018)	19;30 (N = 146)	Sunk-cost judgments at age 19 correlates with sunk-cost judgments at age 30.	Ten first-person vignettes that are Utilization, Progress or both that vary in monetary/time/effort sunk costs. Categorical choice for preference between low/high-cost items.

Huai et al., (2023)	18-29; 60-77 (N = 123)	Sunk-cost judgements decreased with age.	Six pairs of low/high sunk cost first-person Utilization-Progress vignettes with monetary sunk costs. Binary choice whether to use the high-cost item or not. Six pairs of low/high sunk cost first-person Progress vignettes with time/effort sunk costs. Binary choice whether to continue with the activity or not.
Strough et al., (2011b)	18-26; 61-84 (N = 41)	Sunk-cost judgments decreased with age. Investment related-goals were less salient to older adults.	One pair of low/high sunk cost first-person Utilization-Progress vignettes with monetary sunk costs. Categorical choice for how much longer to use the product. One pair of low/high sunk cost first-person Progress vignettes with time/effort as sunk costs. Categorical choice for how much longer to continue the activity.
Strough et al., (2016)	18-85 (N = 258)	Sunk-cost judgments decreased with age. Decrease mediated by less focus on future success of investment.	One first-person Progress vignette with time/effort as sunk cost. Categorical choice whether to continue with the activity or not.
Bruine de Bruin et al., (2007)	18-88 (N = 360)	Sunk-cost judgments decreased with age.	Ten first-person vignettes that are Utilization, Progress or both that vary in monetary/time/effort sunk costs. Categorical choice for preference between low/high-cost items.
Bruine de Bruin et al., (2012)	18-88 (N = 360)	Sunk-cost judgments decreased with age controlling for cognitive ability.	Ten first-person vignettes that are Utilization, Progress or both that vary in monetary/time/effort sunk costs. Categorical choice for preference between low/high-cost items.
Eberhardt et al., (2019)	18-88 (N = 926)	Sunk-cost judgments decreased with age. Partially mediated by experience with financial decisions.	One first-person Progress-Utilization vignette with monetary sunk cost. Categorical choice between low/high-cost items. One first-person Utilization-Progress vignette with monetary sunk cost. Categorical choice for preference between low/high-cost items.

Strough et al., (2008)	18-27; 58-91 (N = 148)	Sunk-cost judgments decreased with age.	One pair of low/high sunk cost first-person Utilization-Progress vignettes with monetary sunk costs. Categorical choice for how much longer to use the product.
Bruine de Bruin et al., (2014)	20-89 (N = 335)	Sunk-cost judgments decreased with age. Rumination associated with sunk-cost judgments.	One pair of low/high sunk cost first-person Progress vignettes with time/effort as sunk costs. Categorical choice whether to continue with the activity or not.
Del Missier et al., (2013)	25-80 (N = 568)	Sunk-cost judgments decreased with age.	Ten first-person vignettes that are Utilization, Progress or both that vary in monetary/time/effort sunk costs. Categorical choice for preference between low/high-cost items.
Del Missier et al., (2020)	60-85 (N = 278)	Older adults showed no change in sunk-cost judgments longitudinally.	Ten first-person vignettes that are Utilization, Progress or both that vary in monetary/time/effort sunk costs. Categorical choice for preference between low/high-cost items.
Roth et al., (2015)	Unknown age range (N = 100 samples)	Sunk-cost judgments decreased with age for Utilization vignettes.	Review that compared Utilization and Progress vignettes.

Note: The measurement properties column notes the number of sunk-cost items, perspective, type (Utilization, Progress, or combination of both), and response scale for measures used in the studies. Utilization measures include the choice between two alternatives that differ by sunk-cost, or the use of a paid-for product and progress measures include deciding whether to continue or abandon a project after initial investment. We ordered the studies by the ages of participants.

Theories that explain older adults' superior ability to resist sunk costs focus more on motivation and experience. For example, Strough and colleagues (2016) found that greater avoidance of sunk-cost judgements with age is mediated by focusing less on potential future success of sunk-cost investments. Moreover, socioemotional selectivity theory posits restricted

temporal horizons lead individuals to set goals that maintain emotional well-being (Carstensen et al., 1999). For example, young adults who imagined they had less time left to live were less susceptible to sunk-cost judgements (Strough et al., 2014). Older adults tend to focus more attention on positive stimuli, possess better emotion regulation and ruminate less about prior loss and future success (Blanchard-Fields, 2007; Strough et al., 2016; Strough, Schlosnagle et al., 201; Sütterlin et al., 2012; Torges et al., 2008). Additionally, older adults possess greater life experience like semantic knowledge and financial experience which may relate to greater avoidance of sunk-cost judgements (Del Missier et al., 2020; Del Missier et al., 2013; Eberhardt et al., 2019; Fennema & Perkins, 2008; Larrick et al., 1990).

The Current Study

We sought to address the methodological gap in the lifespan sunk-cost literature by measuring the magnitude of the SCE across the child to adult lifespan using the same measures for all ages. The studies that have examined the development of the SCE have used inconsistent measurement strategies across narrow age ranges. Although we do not explicitly examine any theoretical accounts of the development of the SCE, our measurement strategy may address inconsistent findings in the literature concerning the prevalence of sunk-cost judgements in childhood and adolescence and provides a more complete picture of sunk-cost judgements across the lifespan.

Experiment 1

Method

Participants

Data were collected from community participants as part of a larger non-pre-registered lifespan cognition study. These participants were recruited through advertisements in local

schools, media, and local community/seniors' centers. We collected data from 724 participants. After excluding 42 participants due to incomplete responses, our final sample included 682 individuals ages 2-97 (Age: $M = 29.9$; $SD = 25.1$; Sex: 61% Female; 38% Male; 1% Unreported)[1]. The most reported ethnicities in our sample were Caucasian, Asian and South Asian. Older adults (i.e., 60+) in our sample were screened for neurological problems (e.g., stroke, head trauma), and completed the Mini Mental State Exam to control for mild cognitive impairment and overall mental health because dementia can be a problem for the battery of cognitive tasks that were part of the larger study. Only one participant scored outside the normal range (24 or better) and was excluded from analyses[2].

Procedure

In the latter portion of a larger, 60-minute study of lifespan cognitive development, participants heard two sunk-cost decision-making vignettes involving a character named Sally whose image appeared on a laminated piece of paper. An experimenter read the vignettes and the response scale. Participants indicated how much pizza Sally would eat after she either baked the pizza herself (Sunk Cost) or received a free pizza (No Sunk Cost). Participants verbally indicated or pointed to one of the options on a laminated piece of paper depicting different amounts of pizza, and the experimenter recorded their response. For children who pointed to the scale, the

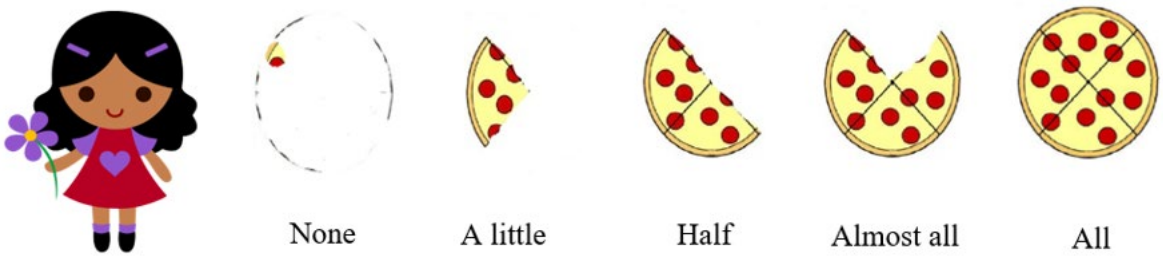
[1] See our Supplementary Material 2a for a histogram of ages and a full table of self-reported ethnicities in our Experiment 1 sample. Note that the youngest participant was 2.51 years and ages were rounded for the purposes of producing the histogram.

[2] We did not conduct a priori power analyses, but simulation-based sensitivity analyses (Supplementary Material 2b) showed we had adequate power to detect effects smaller than the ones we observed.

experimenter often verbally repeated the response to confirm their answer. See Figure 1 for the Pizza vignette.

Figure 1

Experiment 1 Pizza SCE measure



Sunk Cost version: This is Sally. Sally decided to bake a pizza. She shopped for flour and vegetables, and she made her own pizza at home. But, when she pulled the pizza out of the oven and tried a bite, she thought that the pizza didn't taste good. How much of the pizza do you think Sally will eat?

No Sunk Cost version: This is Sally. Sally was at home when her neighbour knocked on the door and gave Sally a free pizza left over from a party, and then the neighbour left. But, when Sally pulled the pizza out of the box and tried a bite, she thought that the pizza didn't taste good. How much of the pizza do you think Sally will eat?

Note: The order of Sunk Cost and No Sunk Cost versions were presented in counterbalanced order.

This scale included more points than those typically used in the literature (e.g., watching 10 minutes, 30 minutes, or an entire bad movie; persisting in or abandoning a drawing; Klaczynski & Cottrell, 2004; Morsanyi & Handley, 2008), and was more quasi-continuous compared to a binary choice (e.g., stop watching the movie or continue watching the movie). By measuring sunk-cost judgements in this way, we hoped to capture subtler differences in the effect (e.g., versus all-or-nothing decisions). Participants completed the two sunk-cost conditions approximately 15 minutes apart, with intervening cognitive tasks. These intervening tasks are beyond the scope of this paper and will not be discussed further.

We define the SCE judgement based on participant scores in each condition (0-4; 0 = Sally will eat none of the pizza; 4 = Sally will eat all the pizza). We calculated the SCE as the difference between scores in the Sunk Cost condition and scores in the No Sunk Cost condition. Therefore, a positive score indicates a sunk-cost judgement, a score of zero represents no sunk-cost judgement, and a negative score represents a reverse sunk-cost judgement (i.e., Sally will eat more of the free pizza than the pizza she made herself). This measure allows us to examine the magnitude of the sunk-cost judgement (e.g., a score of 3 indicates a larger SCE than a score of 1).

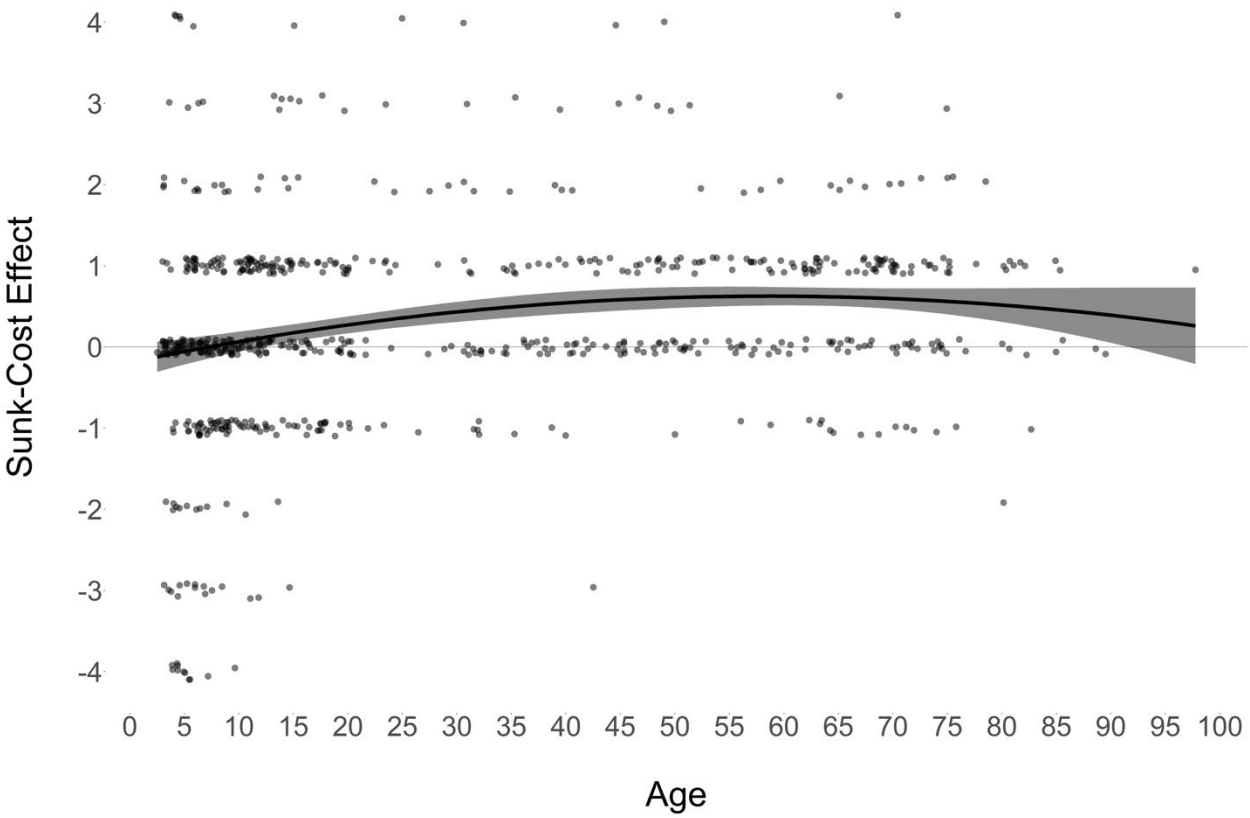
Results

The analyses for Experiment 1 were not pre-registered. Experiment data, analysis scripts and experimental materials can be accessed at: https://osf.io/6hrxz/?view_only=d35b80a9065344ca9a26d11498fa8103.

For our primary analysis, we examined the trajectory of sunk-cost judgements across the lifespan. To test potential relationships between age and sunk-cost judgements, we ran a linear regression predicting the SCE from various mean-centered polynomial transformations of our age variable. We found that linear age significantly predicted the SCE ($t(678) = 6.14$, $p < .001$, as did quadratic age $t(678) = 3.96$, $p < .001$. The cubic age term was not significant, $t(678) = 1.68$, $p = .09$. The final linear + quadratic model explained 7% of the variance in SCE scores. Figure 2 provides a scatter plot of SCE scores by age with the (robust) regression line (including both the linear + quadratic components) superimposed.

Figure 2

Experiment 1 Results: SCE by Age



Note: SCE by age. Points = individual participants, solid line = estimated fit line, regression band = 95% CI on the fit line.

These results show that on average, sunk-cost judgements were absent in childhood, increased through adolescence into adulthood, and remained stable thereafter. Age 13 is the earliest at which the 95% CI on the regression fit line exceeds 0, indicating the emergence of the SCE. Age 91 is the earliest at which the 95% CI intersects 0, indicating the disappearance of the SCE. Responses were generally more variable in children[3]. Due to the relatively few data points that we have in the 80-100 age range, we are hesitant to make any claims about whether the SCE magnitude changes or remains stable in this age group. We also examined analyses on sunk-cost

[3] In the General Discussion, we discuss the possibility that young children under the age of five may have had trouble understanding the sunk-cost tasks.

judgements operationalized as the three discrete decision types sometimes used in the literature: Heuristic (i.e., eating more of the expensive than free pizza), Analytic (i.e., eating the same amount of free and expensive pizza), and Other (i.e., eating more of the free than expensive pizza). Because these analyses are not the focus of the current paper and generally support our magnitude analyses, we do not discuss them further (see Supplementary Material 2c).

Discussion

We found that adolescents and adults, but not children, consistently made sunk-cost judgements. Because the Pizza vignette is a novel measure of the SCE which contains a social aspect (the pizza was given as a gift from a neighbor) and asks participants to make a judgement for someone else (i.e., third-person perspective), we later tested a first-person non-social movie vignette that resembled vignettes used in other sunk cost research (e.g., Strough et al., 2014)[4]. Using data from 128 returning participants between the ages of 7 and 86 years (Age $M = 32.3$, $SD = 25.6$) from the original sample who completed the Pizza vignette, we found the same age trajectory of sunk-cost judgements (see Supplementary Material E). In Experiment 2, we sought to replicate these results and address the limitation of a single vignette that uses a third-person perspective.

Experiment 2

Method

Experiment 2 served as a pre-registered[5] replication and extension of Experiment 1. The crucial changes were the addition of a puzzle vignette (adapted from prior sunk-cost research;

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[4] We thank Wandï Bruine de Bruin and Andrew Parker for raising this idea.

[5] Pre-registration: https://osf.io/s2gur/?view_only=6cec6237fa224128b42bcbfeea3b4abb. There were deviations from the preregistration regarding the Experiment 2 sample size—see Supplementary Material 1 for a summary of these deviations and their potential impact on interpretation of our results.

Strough et al., 2014), and a perspective manipulation – First-person versus Third-person. Experiment 2 was a 2 (Vignette: Pizza, Puzzle; Within-subjects) × 2 (Sunk Cost: Sunk-Cost, No Sunk-Cost; Within-subjects) × 2 (Perspective: First-person, Third-person; Between-subjects) × Age mixed design.

Participants

Data were collected at a local science center, seniors' centers, community centers, and online via Prolific.co, an online crowdsourcing platform. We did not pre-register online data collection but decided to complete data collection with older adults online rather than in-person because of COVID-19. We pre-registered a target sample size of $N = 213$ but ended up collecting data from a substantially larger sample. This decision was made prior to conducting our primary hypothesis test. The main reason for this deviation was that on reaching our initial planned sample size, although we had roughly equal *n*s in each of our *categorical* age groups, there were substantial gaps in the continuous age range (e.g., many children but not many adolescents). These gaps in age ranges would have reduced the interpretability of our continuous age analysis. As such, we continued data collection at local centers, terminating when we obtained an age distribution like that of Experiment 1. We collected data from 463 participants and excluded 85 participants from analyses (53 participants withdrew their data; 12 participants did not complete the experiment; 12 participants did not report their age; 7 participants were missing data on at least one vignette; 1 participant (online) was excluded because self-reported age and age determined from reported birth year was greater than 1 year). Our final sample included 378 participants aged 3-93 years (Age: $M = 30.9$, SD = 26.4; Sex: 58% Female; 41% Male; 1% Other/Unreported). The most reported ethnicities were Caucasian, Asian, and South Asian (See Supplementary Material 3a for a histogram of ages and a full table of self-reported ethnicities in

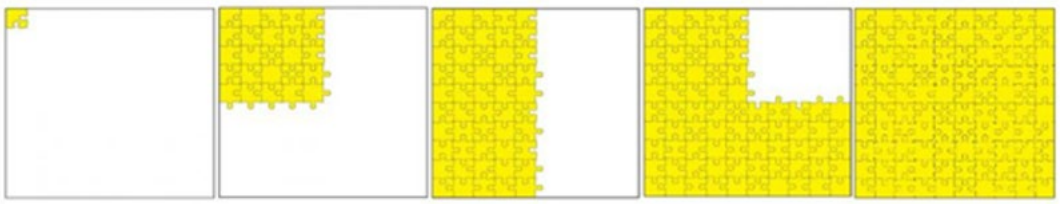
our Experiment 2 sample). We conducted additional post hoc power simulations with our final sample size—these simulations indicated that our Experiment 2 sample size was adequately powered to detect age effects slightly smaller than the effects observed in Experiment 1 (see Supplementary Material 3b).

Procedure

Participants answered a sunk-cost question for each experimental condition (No Sunk-Cost Pizza, Sunk-Cost Pizza, No Sunk-Cost Puzzle, Sunk-Cost Puzzle – either taking their own perspective or the perspective of someone else) in counterbalanced order, following a partial Latin square design. The Pizza vignette was the same vignette that we used in Experiment 1. The Puzzle vignette was adapted from Strough et al., (2014). See Figure 3 for the Puzzle vignette.

Figure 3

Experiment 2 Puzzle SCE measure



Sunk Cost version: Imagine that ***(you/Sally) (have/has)*** a very hard puzzle. After a little while playing with the puzzle, ***(you /Sally)*** got bored with it. ***(You/Sally)*** thought that ***(you/she)*** might not like what the puzzle looked like when it was finished. ***(You/Sally)*** bought this puzzle with ***(your/her)*** own money. How much of the puzzle will ***(you /Sally)*** complete?

No Sunk Cost version: Imagine that ***(you /Sally) (have/has)*** a very hard puzzle. After a little while playing with the puzzle, ***(you /Sally)*** got bored with it. ***(You/Sally)*** thought that ***(you/she)*** might not like what the puzzle looked like when it was finished. ***(You/Sally)*** got this puzzle for a present. How much of the puzzle will ***(you/Sally)*** complete?

Note: The vignette varied by perspective.

After each sunk-cost vignette, participants answered a memory check question which asked how the pizza or puzzle was obtained (i.e., purchased ingredients and baked or received for free). We conducted pre-registered analyses of memory errors (e.g., whether memory errors differed by age, and whether memory errors predicted sunk-cost judgements). Because these analyses are tangential to our main hypotheses, and because there were no effects of memory errors on the SCE, we present these analyses in the Supplementary Material (Sections D6i and D6ii). In Experiment 2, the entire procedure for in-person testing was completed with touch-screen tablets. An experimenter read vignettes to young children who could not read. All other participants read the vignettes and answered on their own. Otherwise, the experiment was the same for participants of all age groups. For online testing, participants completed the task on their own devices.

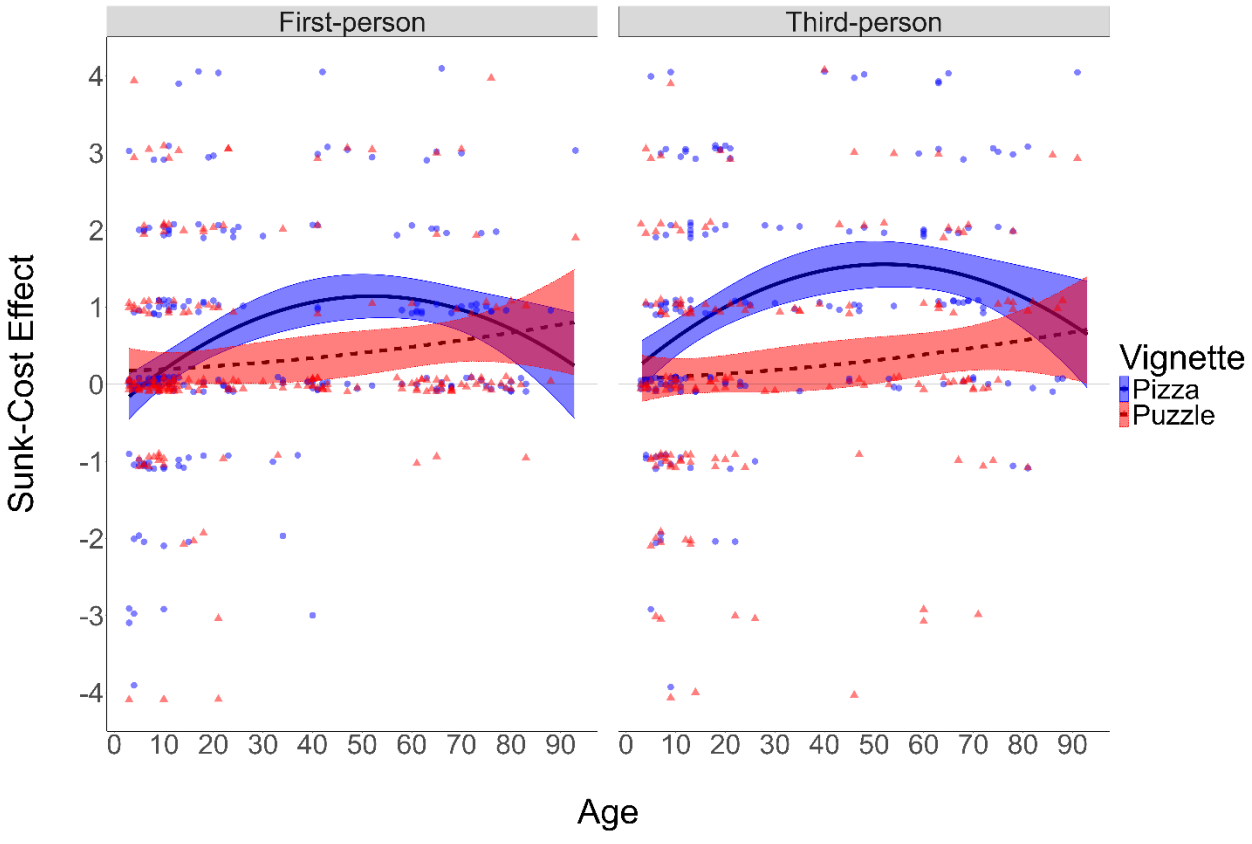
Results

We examined the relations between age, vignette, perspective, and the SCE using 2 (Vignette: Pizza, Puzzle; Within-subjects) × 2 (Perspective: First-person, Third-person; Between-subjects) × Age mixed linear models, with SCE as the dependent variable. This pre-registered analysis collapsed Sunk-Cost and No-Sunk-Cost trials into a difference score for analysis. For age effects, we tested for the presence of linear and quadratic effects. We found significant main effects of Vignette ($\chi^2(1) = 21.86$, $p < .001$), significant linear and quadratic Age effects ($\chi^2(2) = 27.92$, $p < .001$), a significant Vignette × Perspective interaction ($\chi^2(1) = 7.55$, $p = .006$), and a significant Vignette × Age interaction ($\chi^2(2) = 12.85$, $p = .002$). All other effects were non-significant ($\chi^2 < 2.21$, ps $> .13$). The final model explained 7% of the variance in SCE scores

(same as Experiment 1). Figure 4 depicts robust regression lines and jittered individual data points for SCE magnitude by Age, Vignette, and Perspective. The emergence of the SCE indicated by the 95% CI on the regression fit line exceeding 0 occurred at 11 and 4 for the for the first-and-third-person pizza vignettes, and 13 and 49 for the first-and-third-person puzzle vignettes. The SCE disappeared at ages 86 and 92 for first-and-third-person pizza vignettes. Although not the focus of the current paper, we also conducted three additional pre-registered analyses on categorical instead of continuous age (see Supplementary Material 3c), predicting categorical sunk-cost decision types (Heuristic, Analytic, Other) from continuous age, perspective, and vignette (see Supplementary Material 3d), and the effect of memory errors on the SCE (see Supplementary Material 3e).

Figure 4

Experiment 2 Results: SCE by Age, Vignette and Perspective



Note: SCE by Age, Vignette, and Perspective. Regression bands = 95% CI on the fit lines.

Discussion

These results replicate the results of Experiment 1: The SCE was absent in childhood and increased with age—with some qualifications. In the Pizza vignette, our results resembled those of Experiment 1—a lack of a SCE in young children and a smaller SCE in older compared to younger adults. Consistent with previous research, we found that there was no difference in sunk-cost decision-making across different perspective conditions (Hamzagic et al., 2021; Olivola, 2018; Sehl et al., 2021). Most importantly, young children showed a similar pattern with the Puzzle vignette compared to the Pizza vignette whereby sunk-cost judgements emerged in adolescence and increased linearly.

However, we did find differences in the trajectory of sunk-cost judgements across the vignettes. The rate of increase of sunk-cost judgements after childhood was more pronounced in the Pizza vignette. In the Puzzle vignette we see a more gradual increase in sunk-cost judgements. The Puzzle vignette also resulted in a lower overall SCE. This may be related to the Pizza vignette being more of a utilization measure, whereas the Puzzle vignette introduces a progress element. Moreover, we found a slight decrease in sunk-cost judgements in older adults for the Pizza vignette but not the Puzzle vignette. We are again cautious about interpreting this apparent decline in SCE magnitude in the Pizza vignette in older adulthood, given the relative paucity of data at the oldest ages. Finally, differences between vignettes may be reduced when people consider those vignettes from a First-person perspective. Additionally, although general age patterns may be similar across vignettes, the shape of age trends may differ.

General Discussion

We explored age-related changes in sunk-cost judgements across the lifespan using consistent measurement for all participants, allowing us to make direct comparisons among participants of all ages. Across two experiments, we found adolescents and adults, but not younger children, consistently made sunk-cost judgements. These data patterns differ from traditional dual-processing propositions that children more often make sunk-cost judgements which decrease with age (Strough et al., 2011a).

We found that in relation to monetary and time-based sunk costs, sunk-cost decisions were not reliably present in early childhood and emerged in early adolescence. Some research suggests that although children do appreciate and recognize sunk costs by valuing objects that come with greater cost to obtain and predicting negative emotions for the loss of such objects (Jara-Ettinger et al., 2015; 2016; Pesowski et al., 2016), they have difficulty predicting sunk-cost behavior (Sehl et al., 2021; 2024a). It may be that some young children incorporate sunk costs in decision-making (e.g., children with greater cognitive development; Morsanyi & Handley, 2008), but these decision-making strategies generally develop later into early adolescence. Our results suggest that as children age, they may increasingly incorporate previous investments into decision-making judgments.

Previous cross-sectional research on sunk-cost judgements over the adult lifespan found that adults are better able to avoid sunk-cost judgements with age (Bruine de Bruin et al., 2007; 2012; 2014; Del Missier, 2013; Eberhardt; 2019). Our analyses suggest that sunk-cost judgements are present and stable in adulthood. We observed mixed results for sunk-cost judgements in older adulthood. In Experiments 1 and 2 (using the Pizza and Movie vignettes), sunk-cost judgements increased into older adulthood before declining slightly. With the Puzzle

vignette, sunk-cost judgements did not decrease in older adulthood. Rather, sunk-cost judgements increased gradually into older adulthood. Perhaps the context and type of costs involved can modulate the relationship between age and sunk-cost judgements. It is possible that the simple vignettes used in this study did not elicit motivational and experiential processes that are associated with older adults being more resistant to sunk costs (Bruine de Bruin et al., 2014; Eberhardt et al., 2019; Strough et al., 2011b; 2016). Moreover, progress scenarios (puzzle) are less susceptible to age effects (Roth et al., 2015).

Our results also have implications for the theoretical explanations of the development of sunk-cost judgements in childhood. We did not test specific theoretical accounts of the development of the SCE. However, we do not find evidence to support traditional dual processing accounts that children primarily focus on sunk-costs, after which the development of deliberate decision-making abilities reduces susceptibility to sunk-cost judgements (Klaczynski & Cottrell, 2004; Strough et al., 2011a; Strough et al., 2015). Rather, our data support accounts that children do not consistently consider previous investments when making sunk-cost judgments until early adolescence. There may be other processes like expectations to behave rationally, failing to see investments as wasted, not incorporating negative emotions from sunk costs into judgements about future behavior, and mental accounting that are responsible for the lower likelihood to make sunk-cost judgements in childhood (see Sehl et al., 2021; 2024a). That is not to say children are incapable of recognizing personal investment and always make sunk-cost resistant judgements. Perhaps making sunk costs more salient to children (e.g., highlighting effort and negative emotions associated with sunk costs) better allows children to use sunk-cost reasoning and make the connection between sunk-cost and future actions (Sehl et al., 2024b).

Although we tested all ages using consistent measurement, there are limitations with this

approach. First, we note young children (especially those under 5-years-old) may not have understood the sunk-cost tasks. Young children often showed random decision-making and commonly chose the upper end of the response scales, which could be the result of not understanding the questions, not considering sunk costs, and basing decisions on other factors like thinking all pizza is good. Young children may have also had trouble with the sunk-cost measures due to metacognitive demands of the task. For example, young children who did not understand the questions would fail to see the connection between current and previous sunk-cost conditions. For example, young children may not reference or remember the amount of pizza eaten in the free condition when deciding how much pizza to eat in the sunk-cost condition. To address concerns that young children failed to understand the tasks, we ran the primary analyses excluding children below age five to compare to the age trajectories we found in the full sample. We found no meaningful differences in our results with young children excluded from analyses (see Supplementary Material 2d for Experiment 1 and Supplementary 3f for Experiment 2). Second, our materials contained a social element (e.g., the pizza was given by a neighbor). However, Olivola (2018) found that social connectedness to others does not moderate the SCE, and the non-social movie vignette we tested in Experiment 1 yielded the same age pattern. Lastly, the data are cross-sectional; thus, we cannot make strong developmental claims about changes in sunk-cost judgements across the lifespan.

Conclusion

Using two large, all-ages samples with consistent measurement of the SCE for all ages, we found that sunk-cost judgements were absent in childhood and emerged in adolescence, after which sunk-cost judgements remained stable and may have decreased slightly into older adulthood (in the Pizza Vignette). We also found a different trajectory of sunk-cost judgements

over adulthood across vignettes. Therefore, different sunk-cost measures/contexts may yield different sunk-cost judgement trends over the adult lifespan. Overall, we hope that our results spur researchers to consider sunk-cost judgements in a lifespan context.

Declarations

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Conflicts of interest/Competing interests: Not applicable

Ethics approval: This project was reviewed and approved by Kwantlen Polytechnic University's research ethics board (REB #2014-016).

Consent to participate Informed consent was obtained from all individual participants included in the study.

Consent for publication: Participants signed informed consent regarding publishing their data.

Availability of data and materials: Data files analyzed, and materials can be accessed anonymously on OSF at the following link: https://osf.io/6hrxz/?view_only=d35b80a9065344ca9a26d11498fa8103

Code availability: R code for all analyses can be accessed anonymously on OSF at the following link: https://osf.io/6hrxz/?view_only=d35b80a9065344ca9a26d11498fa8103

Open practices statement: The preregistration for Experiment 2 that includes all data and materials can be accessed anonymously at the following link: https://osf.io/6hrxz/?view_only=d35b80a9065344ca9a26d11498fa8103. Deviations from this preregistration are listed in Supplementary Material 1.

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