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Children's detection of online misinformation

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ABSTRACT

Adults' ability to detect online misinformation is improved by cognitive reflection and targeted instruction. Is the same true for children, who are also on the internet and may also be exposed to online misinformation? We explored this question by asking children aged 4 to 12 ($N = 135$, 54 % female, 31 % white) to judge the veracity of news stories that had circulated on the internet, some real and some fake. We compared their differentiation of fake news from real news to their performance on a developmental version of the Cognitive Reflection Test, the CRT-D. We also administered a brief tutorial encouraging children to scrutinize the plausibility of a story's content or the credibility of its source. Children's differentiation of fake news from real news was strongly correlated with their CRT-D scores but did not improve with instruction; rather, instruction made children more skeptical of all news. A comparison group of adults ($N = 117$) demonstrated similar findings with the exception that instruction improved adults' differentiation of fake news from real news for those who received source-based instruction. These findings indicate that the evaluation of online news is aided by cognitive reflection from the start and that knowledge of news sources, and news production more generally, may be critical for developing adult-level competencies at detecting online misinformation.

1. Introduction

Before the internet, the news landscape looked very different. News was disseminated by teams of professional reporters, editors, and fact checkers who systematically vetted the stories they published. Although professional journalists were not immune to mistakes or bias, they employed a set of standards that ensured that the news they reported was generally accurate. This assumption is no longer valid in the age of digital media. Anyone can post anything on the internet, and false posts can be shared as easily as true ones. Indeed, studies of how information spreads on social media have found that fake news—or news designed to deceive or mislead—spreads faster and farther than real news (Vosoughi, Roy, & Aral, 2018).

The prevalence of false or misleading information on the internet forces internet users to grapple with the challenge of detecting it. This challenge is epistemically complex; it requires coordinating factual knowledge of events that have (or have not) happened, conceptual knowledge of events that are likely (or unlikely) to happen, and social knowledge of reliable (and unreliable) informants. Such epistemic demands can be burdensome for any internet user (van der Linden, 2023), but they are perhaps most burdensome for the internet's youngest users: elementary-school-aged children.

Most elementary schoolers in the US have regular access to the internet and routinely use the internet for both entertainment and education (Rideout & Robb, 2020). But children of this age have a limited understanding of what the internet is and how it works. Many think that information found on the internet is generally accurate, particularly younger children (Girouard-Hallam, Tong, Wang, & Danovitch, 2023). Many also think that the credibility of a website can be gleaned from its appearance (Metzger, Flanagin, Markov, Grossman, & Bulger, 2015). When searching for information online, they avoid websites that contain typos but are largely indifferent to websites that contains exaggerations, like "it snows everyday during winter," or falsehoods, like "seals are bright green mammals" (Einav, Levey, Patel, & Westwood, 2020), likely because they fail to register these errors. A national survey of elementary schoolers in the UK found that only 3 % were able to identify which of six news stories were false (National Literacy Trust, 2018).

Older children's understanding of the internet is not much better. Many middle schoolers fail to recognize that some websites are hoaxes, such as websites on male pregnancy (Metzger et al., 2015) or the Pacific Northwest Tree Octopus (Loos, Ivan, & Leu, 2018), and most middle schoolers have trouble explaining why sponsored content from a bank

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might not provide objective financial advice or why statistics cited in the comments section of a news site should not be included in a research paper (McGrew, Breakstone, Ortega, Smith, & Wineburg, 2018). Most middle schoolers also have trouble discriminating news stories from other content posted online such as opinion pieces and sponsored advertisements (McGrew et al., 2018). Even high schoolers tend to evaluate the credibility of a source based solely on what the source has posted about itself (Wineburg, Breakstone, McGrew, Smith, & Ortega, 2022).

In the present study, we explore children's susceptibility to online misinformation in the context of a controlled paradigm used to study adults' susceptibility: a fake news detection task, pioneered by Pennycook and Rand (2019). Participants in this task are shown a variety of news stories, some real and some fake, and asked to judge the veracity of each. Successful performance on this task varies with several factors, including partisan identity (Roozenbeek et al., 2022), social media habits (Ceylan, Anderson, & Wood, 2023), and aging (Brashier & Schacter, 2020). Two additional factors, potentially relevant to children, are reflection and instruction. Adults who exhibit higher levels of cognitive reflection, or the ability to identify and override erroneous intuitions, are better at discriminating fake news from real news (Batailler, Brannon, Teas, & Gawronski, 2022; Pehlivanoglu et al., 2021; Pennycook & Rand, 2019), as are adults instructed to focus on the accuracy of the stories they are reading (Martel et al., 2024; Panizza et al., 2022; Pennycook & Rand, 2022).

Here, we investigate how well children are able to differentiate fake news from real news and whether this ability is influenced by reflection and instruction. Children have less knowledge to apply to the challenge of detecting fake news, either content knowledge or source knowledge, but this deficit does not necessarily render them more credulous. Ample research indicates that children are naturally skeptical of dubious information (Woolley & Ghossainy, 2013) and dubious informants (Mills, 2013), and the current study explores whether, and how, that skepticism manifests itself in the context of online misinformation and in relation to children's emerging reflectiveness about their own cognition. Cognitively reflective children have been shown to prioritize analysis over intuition across a variety of reasoning tasks (Shtulman & Young, 2023), and such skills may aid children in differentiating plausible news stories from implausible ones as well as credible news sources from noncredible ones.

2. Children's evaluation of secondhand information

Children's susceptibility to misinformation on the internet stands in stark contrast to their vigilance toward accepting dubious information in other contexts. When children encounter implausible information in a conversation or storybook, they are highly skeptical. Children as young as three easily recognize when events violate physical laws and classify such events as magic (Johnson & Harris, 1994). They also recognize that people cannot violate physical laws and reject stories in which people grow smaller, stay awake forever, walk through a wall, or float in the air (Browne & Woolley, 2004; Sobel, 2004).

If children do err in their judgments of possibility, they err on the side of judging *too little* possible (Woolley & Ghossainy, 2013). Young children not only reject events that violate physical laws but also reject events that violate mere regularities—events that are improbable but not impossible, like drinking onion juice or finding an alligator under the bed (Shtulman & Carey, 2007). Young children correctly claim a person could not own a pet unicorn in real life, but they incorrectly claim a person could not own a pet peacock; they correctly claim a person could not make lightning-flavored ice cream, but they incorrectly claim a person could not make pickle-flavored ice cream (Goulding & Friedman, 2021; Shtulman, Goulding, & Friedman, 2024). Children's tendency to judge improbable events impossible has been observed across contexts (Williams & Danovitch, 2022), cultures (Nissel et al., 2024), and instruction (Lane, Ronfard, Francioli, & Harris, 2016).

This conflation of improbability with impossibility suggests that children's judgments of whether an event could happen are based on superficial reactions, such as surprise or confusion, rather than reasoned considerations, such as whether the event violates a known principle. Indeed, children's ability to differentiate improbable events from impossible events improves not only with age but also with cognitive reflection (Shtulman et al., 2023), implying that children's initial skepticism about the plausibility of unexpected events is broad but shallow.

Another form of skepticism that children exhibit from an early age is skepticism about who to believe. Children do not believe just anyone; they selectively trust some informants over others. When confronted with two informants asserting contradictory claims, children as young as two side with the informant demonstrating greater accuracy, knowledge, or competence (Harris, Koenig, Corriveau, & Jaswal, 2018), and they make such assessments when considering a variety of claims, including claims about the names of objects, the functions of tools, the rules of games, and the locations of toys (Mills, 2013). By five, children can even tell which of two informants is more trustworthy when both have stated true facts but the facts stated by one informant are misleading (Levush & Butler, 2024).

Epistemic qualifications like accuracy and knowledge are not, however, the only cues children take into account when deciding who to trust. Children also consider superficial cues such as how attractive an informant is or whether they speak with a foreign accent (Lascaux, 2020). Children are particularly swayed by whether an informants' claims are written down. As soon as children can read, they defer to text as an authoritative source of knowledge (Robinson, Einav, & Fox, 2013) and privilege written information over oral information (Corriveau, Einav, Robinson, & Harris, 2014; Einav, Robinson, & Fox, 2013). Even children who are poor readers themselves side with written assertions over oral ones (Chandler-Campbell, Ghossainy, Mills, & Corriveau, 2022).

Writing also overrides children's inclination to reject implausible claims (Eyden, Robinson, Einav, & Jaswal, 2013). If, for instance, they are shown a hybrid animal that looks mostly like a bird and partly like a fish, they will accept that the animal is a fish if labeled "fish." Children who are simply told the animal is a fish reject that assertion, insisting that it is a bird instead. Children's willingness to trust text over their own intuitions is potentially problematic when applied to the internet, where all information is conveyed by text, accurate or not.

These findings indicate that children are epistemically sophisticated in some ways but naïve in others. They exhibit a healthy dose of skepticism in the face of implausible claims and unreliable informants, but they can be persuaded to change their minds by the trappings of authority and authenticity. Such trappings abound on the internet, where children do appear to be swayed by professional-looking formatting and professional-sounding credentials (McGrew et al., 2018; Metzger et al., 2015). In the present study, we further explore the tension between children's early skepticism and their receptivity to seemingly official testimony by measuring how well they can parse real information from misinformation when both are presented in the same journalistic format.

3. The role of reflection in detecting fake news

Cognitive reflection is the disposition to privilege analysis over intuition. It is traditionally measured with Frederick's (2005) Cognitive Reflection Test or CRT. The CRT consists of three math problems that elicit intuitive, yet inaccurate, responses correctable with a reanalysis of what the problem asks. Cognitive reflection has been associated with several hallmarks of rational thought, including sensitivity to base rates, sensitivity to sample size, recognition of statistical fallacies, and discounting of sunk costs (Toplak, West, & Stanovich, 2011). Conversely, a lack of reflection has been associated with epistemically questionable practices, such as rejecting science, accepting conspiracy theories, adhering to superstition, and agreeing with bullshit (Pennycook,

Fugelsang, & Koehler, 2015).

Acceptance of fake news is another epistemically questionable practice predicted by low cognitive reflection. In a pioneering study of adults' susceptibility to online misinformation, Pennycook and Rand (2019) presented adults with real and fake political news, such as "Trump strikes conciliatory tone in meeting with tech executives" from wsj.com (a real story) and "Trump to ban all TV shows that promote gay activity" from colossill.com (a fake story). They found that adults were generally poor at discriminating fake stories from real stories, but discrimination varied with cognitive reflection; those who performed better on the CRT were also better at discriminating the two types of stories.

The correspondence between cognitive reflection and fake news detection has been replicated with many news stories and in many participant populations (e.g., Bago, Rand, & Pennycook, 2020; Batailler et al., 2022; Lemaire, Ye, Le Stanc, Borst, & Cassotti, 2025; Maertens et al., 2024; Pehlivanoglu et al., 2021; Saltor, Barberia, & Rodríguez-Ferreiro, 2023). Cognitive reflection is not only a consistent predictor of news evaluation but also a stronger predictor than partisan identity (Pennycook & Rand, 2021). Adults tend to judge stories that align with their political beliefs as more accurate than those that challenge their beliefs, but this tendency is overshadowed by the benefits of reflection such that adults with high CRT scores are better at detecting fake news than those with low scores regardless of its political content.

The value of reflection independent of content suggests that reflection may improve children's news evaluation as well. Children cannot be

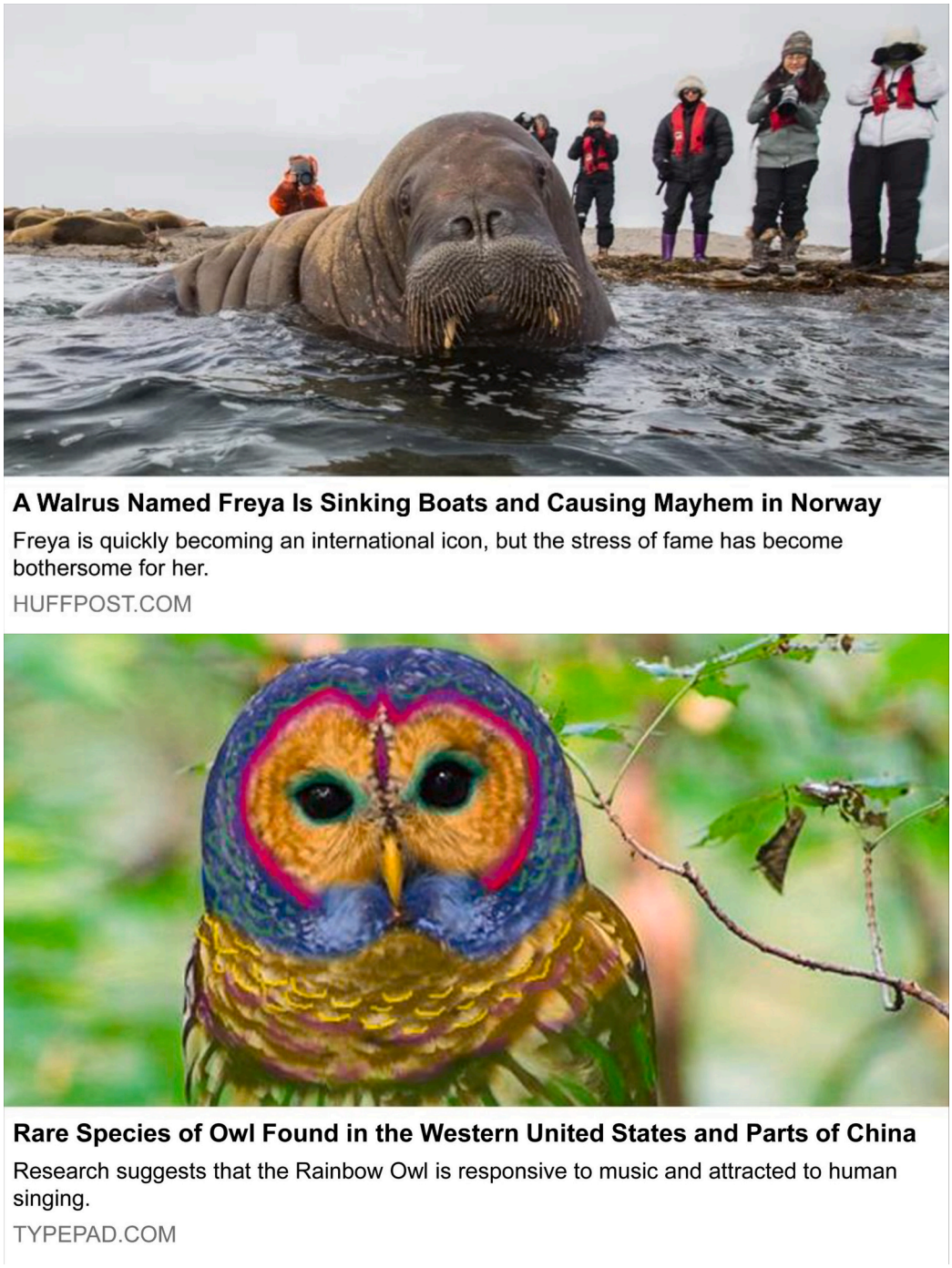

Fig. 1. Examples of real news (top) and fake news (bottom).

expected to identify political misinformation, as they know little of politics, but misinformation comes in many flavors. Consider the two stories presented in Fig. 1: a real story about a walrus "sinking boats and causing mayhem in Norway" (from huffpost.com) and a fake story about a rainbow owl "responsive to music and attracted to human singing" (from typepad.com). Both stories were widely circulated on the internet and could easily have been viewed by children. Might cognitive reflection have assisted children in recognizing that only the walrus story is true?

Previous research has shown that adolescents' scores on the CRT predicts their ability to differentiate real news from fake news (Lemaire et al., 2025), but the CRT is too mathematically demanding to administer to elementary-school-aged children. We administered instead the Cognitive Reflection Test, Developmental version, or CRT-D (Young & Shtulman, 2020a). The CRT-D consists of nine brainteasers appropriate for children as young as four. A sample question is "What do cows drink?", which elicits the intuitive response "milk." This response can be identified as wrong with reflection on the fact that cows produce milk but do not drink it; they drink water.

Children's scores on the CRT-D predict several measures of rational thought, such as privileging evidence over anecdotes, selecting favorable outcomes by probability rather than frequency, and drawing inferences from counterintuitive premises (Gong, Young, & Shtulman, 2021). Children's CRT-D scores also predict several facets of higher-order cognition, including scientific reasoning (Young & Shtulman, 2020b), mathematical reasoning (Kirkland, Guang, Cheng, & McNeil, 2024), statistical reasoning (Young & Shtulman, 2024), and reasoning about possibility (Shtulman et al., 2023). The CRT-D thus provides a comparable alternative to the CRT for investigating how reflection influences children's news evaluation.

4. The role of instruction in detecting fake news

Adults' detection of fake news can be improved with a variety of interventions. Teaching adults internet search strategies, such as resisting the urge to click on the first search result or investigating the origins of a photo with reverse image search, improves their differentiation of fake news from real news (Moore & Hancock, 2022). Showing adults videos about common forms of online manipulation, such as creating false dichotomies or making ad hominem attacks, improves their subsequent detection of manipulative web content (Roozenbeek, Van Der Linden, Goldberg, Rathje, & Lewandowsky, 2022), as does involving them in a video game covering the same topics (Roozenbeek & Van der Linden, 2019). Even simple interventions work. Paying adults for correct judgments of whether a story is true or false yields higher rates of fake news detection (Panizza et al., 2022), and asking adults to rate the accuracy of a single fake news story reduces their subsequent willingness to share other fake stories (Pennycook et al., 2021).

Similar interventions have proven effective for adolescents. High schoolers trained to identify techniques for manipulating trust, such as impersonating experts, fueling polarization, or floating conspiracy theories, are better at identifying social media posts that exemplify these techniques (Axelsson, Nygren, Roozenbeek, & van der Linden, 2024). High schoolers trained to "read laterally," or verify the accuracy of an online post by searching for what other online sources say about the post, are better at spotting and dissecting online misinformation (Wineburg et al., 2022; see also Brodsky et al., 2021). And middle schoolers shown the consequences of sharing misinformation through a game-based simulation are better at identifying social media posts that should not be shared (Barzilai et al., 2023).

Such interventions, though useful for adolescents, are too complex for elementary schoolers. Children of this age are unfamiliar with politics, so trainings that focus on partisanship or polarization (e.g., Axelsson et al., 2024) are unlikely to resonate. Children of this age also have limited ability to search the internet themselves, as many are still learning to read and write, so trainings that encourage lateral reading (e.g., Wineburg et al., 2022) are not yet appropriate either.

Accordingly, we designed our own trainings—trainings that highlight aspects of a news story that elementary schoolers should be able to evaluate in light of their natural skepticism toward dubious information and dubious informants. Specifically, we encouraged children to scrutinize the plausibility of a story's content or the credibility of a story's source. Both tactics have proven successful in a classroom setting, where teaching children to question implausible claims (Sinatra & Lombardi, 2020) or unreliable sources (Brante & Strømsø, 2018) improves text comprehension and inferential reasoning. Naturally, older children should be more successful at these tasks than younger ones given that they have more knowledge relevant to both content and sources, but even younger children could benefit from the prompt to reflect on a story's legitimacy if their evaluations would otherwise be based on superficial impressions.

5. Current study

Our study is the first to explore elementary school-aged children's differentiation of fake news from real news. We designed trainings appropriate for this age group as well as assessment materials. The assessment materials consisted of news stories that circulated on the internet whose truth would be challenging to discern but whose content was neither too complex nor too mature for use with children. Whereas adult studies have typically used political stories (following Pennycook & Rand, 2019), we used stories that covered child-friendly topics such as food, weather, animals, vehicles, and social customs. To assess the overall discriminability of our fake stories from our real stories, we tested adults alongside children. We expected that adults' discriminations would correlate with individual differences in cognitive reflection and would improve with instruction, but it was an open question how well children would discriminate real news from fake news and whether that discrimination would track the same variables.

6. Method

The protocol and stimuli for this study were approved by Occidental College's Institutional Review Board (approval code SP23–03-SHT).

6.1. Participants

The participants were 135 children between the ages of 4 and 12 (*M* age = 8.1). We targeted children old enough to complete our measures of cognitive reflection but not so old as to have their own social media accounts. Children in this age range have different amounts of experience with the internet but could all be considered novices with respect to evaluating a news feed. The youngest children in our sample were least likely to have been exposed to online news, but their judgments provide a baseline for how children might evaluate such news on first encounter.

Child participants were recruited from public parks in the Los Angeles area and tested onsite using iPads. According to parental report, 54 % of the children were female and 46 % were male; 31 % were white, 23 % were mixed race, 16 % were Hispanic or Latino, 13 % were Asian, and 4 % were a different race or ethnicity (Black, Indian, Armenian). The race of the remaining 15 % was unreported. Parents of child participants were not asked to report their income; however, the median household income for residents in the main recruitment area (Pasadena) is $103,778, with 13.2 % of the population living below the poverty line (U.S. Census Bureau, 2020). Children were distributed fairly evenly across the age range; 7 % were four, 16 % five, 16 % six, 14 % seven, 14 % eight, 13 % nine, 7 % ten, 4 % eleven, and 9 % twelve.

We also tested 117 adults between the ages of 18 and 22. Adult participants were recruited from psychology and cognitive science courses at Occidental College and compensated with course credit. They were not asked to provide any demographic information. Adults completed all tasks in the form of an online survey.

Sample size was determined by testing period. We sampled as many children as possible over the course of one semester and one summer (January through August 2023) and as many adults as possible over the course of one semester (January through May 2023) with the goal of sampling at least 100 participants in each age group. Retrospective power analyses using G*Power 3.1.9.6 indicate that both samples were sufficiently powered to detect a moderate within-participants effect ($d = 0.5$) with more than 95 % probability and a small within-participants effect ($d = 0.25$) with more than 80 % probability.

6.2. Procedure

The first task that all participants completed was the CRT-D, including adults. Adults perform substantially better on the CRT-D than children, but they still exhibit robust variability, and this variability correlates with other measures of cognitive reflection, including the original CRT, as well as standard measures of rational thought and normative thinking dispositions (Gong et al., 2021).

The nine items of the CRT-D were presented in random order, and participants were scored on the number of items answered correctly. Consistent with prior research (Young & Shtulman, 2020a), children answered an average of 3.0 items correctly ($SD = 2.2$), and scores were strongly correlated with age in months ($r = 0.61$, $p < .001$). Adults answered an average of 7.7 items correctly ($SD = 1.4$), and most (62 %) answered fewer than nine correctly.

Following the CRT-D, participants evaluated the truth of 24 news stories, 12 real and 12 fake. Children's evaluations were elicited with two questions. First, they were asked whether the story was true or false. Second, they were asked whether the story was "definitely" true/false or "probably" true/false. Together, these questions comprised a four-point rating scale, ranging from "definitely false" (scored 0) to "probably false" (1) to "probably true" (2) to "definitely true" (3). Adults rated each story using the same scale with all options presented at once.

The 24 news stories were broken into two blocks of 12 presented before and after a brief training on how to evaluate the veracity of a news story (described below). Each block contained six real stories and six fake stories, and the blocks were counterbalanced across participants so that the block that served as pretest for half the participants served as posttest for the other half. The stories within each block were presented in a random order.

6.3. Materials

All news stories were culled from Snopes.com, a fact-checking website. Snopes investigates questionable stories that circulate on the internet and determines whether those stories are true or false. We searched Snopes's list of true stories for suitable exemplars of real news and its list of false stories for suitable exemplars of fake news. The stories' appearance on Snopes.com ensured that all stories were implausible enough to raise suspicion but not so implausible as to be dismissed out of hand. Most stories that appear on Snopes.com are political and thus unsuitable for children. We limited our selection to stories that children would be able to evaluate on the basis of general knowledge, such as stories about unusual animals, unusual technology, or unusual events. The full list can be found in the Supplemental Materials.

The stories were presented as they would appear on social media: a headline, an image, a brief summary, and a URL source, as depicted in Fig. 1. Most stories were presented as they had originally appeared on the internet, but some were slightly edited to fit the chosen format. Stories that lacked a summary were supplemented with text from the main body, and stories that lacked an image were supplemented with a generic image related to that topic. Stories were also selected from different sources to prevent the possibility that participants' evaluation of a story could have been influenced by their evaluation of other stories from the same source.

Sandwiched between two blocks of stories was a training. The training focused on either the plausibility of a story's content or the credibility of its source. The content training encouraged participants to ask themselves whether the story makes sense given what they know about the topic and whether it makes sense given what they know about the world in general. The source training encouraged participants to ask themselves whether the story comes from a professional news organization, and, if they cannot tell, whether it is reported neutrally and objectively.

Each strategy was modeled with two examples of fake news: a story titled "California newborn becomes first baby to be named an emoji: Her name is [heart-eyes][heart-eyes][heart-eyes]" from prettycoolsite.com and a story titled "Man hospitalized after his apple airpods exploded in his ear" from huzlers.com. Trainings took approximately five minutes to complete. Children were led through the training by an experimenter; adults read through the training on their own. The protocols for each training can be found in the Supplemental Materials.

Due to experimenter error, more children received the content training ($n = 83$) than the source training ($n = 52$). However, the type of training children received did not influence any of the results reported below. All assessment materials and training materials are available on the Open Science Framework (tinyurl.com/mv8x3fth); all data and analyses are also available at this site.

7. Results

We analyzed participants' news evaluation skills using three metrics: truth ratings, judgment accuracy, and news differentiation scores. Truth ratings were first-order judgments of whether a story was definitely false (0), probably false (1), probably true (2), or definitely true (3). These ratings were averaged by story type (real vs. fake) and assessment period (pretest vs. posttest), yielding four composites per participant.

Judgment accuracy was analyzed at the item level. Each truth rating was converted into a binary score (1 = correct, 0 = incorrect). A response was coded as correct if a participant judged a real story as "probably true" or "definitely true," or if they judged a fake story as "probably false" or "definitely false."

News differentiation scores were also derived from participants' truth ratings. Participants' average truth rating for fake news was subtracted from their average truth rating for real news at each assessment period. A score of 3 would indicate perfect differentiation of real news from fake news, achievable only if every real story was judged "definitely true" and every fake story was judged "definitely false." A score of 0 would indicate no differentiation of the two types of news. News differentiation scores correspond to what Pennycook and Rand (2019) term "media truth discernment." They provide a global assessment of participants' news evaluation skill and, accordingly, they are the metric we use to determine whether individual differences in news evaluation are predicted by cognitive reflection.

Because the focus of this study is children's news evaluation, we analyze children's judgments separately from adults'. Adults were expected to differentiate fake news from real news with high fidelity, so their performance serves as a benchmark for interpreting the sufficiency of children's performance.

We analyzed participant data with (generalized) linear mixed-effects models (LMM/GLMM) using the *lme4* package (Bates, Mächler, Bolker, & Walker, 2015). All models were fit with maximal converging random-effects structures (Barr, Levy, Scheepers, & Tily, 2013). We tested fixed effects using Type II Wald F tests with Kenward–Roger degrees of freedom for LMMs and Type II likelihood-ratio χ^2 tests for GLMMs. We estimated marginal means and simple effects using the *emmeans* package (Lenth, 2025).

7.1. Truth ratings

As shown in Fig. 2, both adults and children reliably differentiated

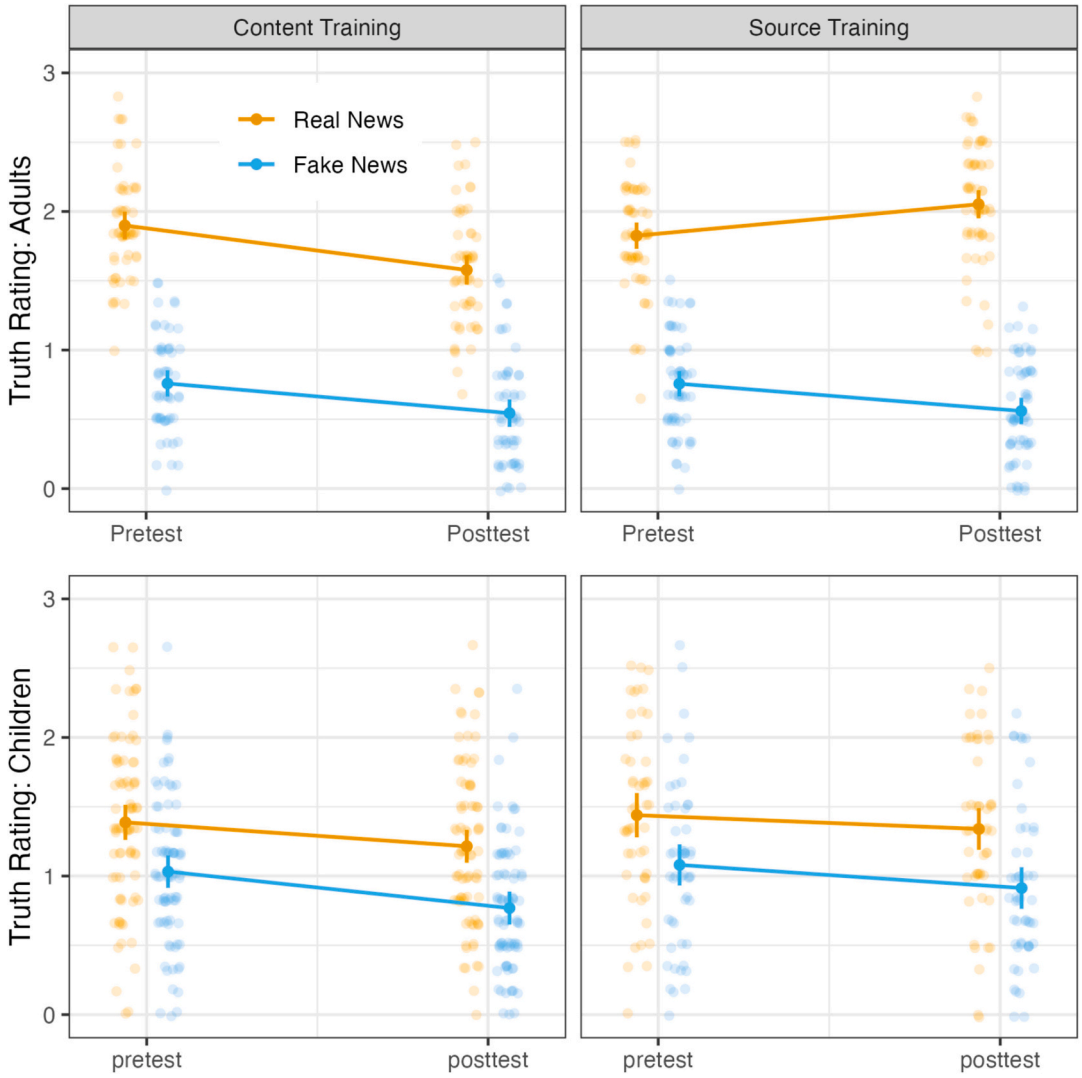

Fig. 2. Estimated mean truth ratings for adults (top) and children (bottom) before and after training. Error bars represent 95 % CIs and jittered points represent raw participant means.

fake news from real news, rating real news as more true than fake news at each assessment period. Adults differentiated news types more successfully than children, particularly after source training.

We analyzed mean truth ratings by fitting separate LMMs for adults and children, with fixed effects of news type (fake vs. real), training type (content vs. source), assessment period (pretest vs. posttest), and their interactions, along with by-participant random intercepts and slopes for news type and assessment period. Adults' truth ratings varied by news type, $F(1, 115) = 817.29$, $p < .001$, assessment period, $F(1, 115) = 16.41$, $p < .001$, and marginally by training type, $F(1, 115) = 3.45$, $p = .066$. These effects were qualified by a three-way interaction, $F(1, 115) = 24.28$, $p < .001$. For adults who received content training, skepticism increased across the board. From pretest to posttest, their truth ratings decreased for fake news ($M = 0.76$ to 0.55; $\Delta = -0.21$, 95 % CI [−0.33, −0.10]), as well as for real news ($M = 1.90$ to 1.58; $\Delta = -0.32$, 95 % CI [−0.44, −0.21]). A different pattern emerged for adults who received the source training. From pretest to posttest, they rated real news as more true ($M = 1.83$ to 2.05; $\Delta = 0.23$, 95 % CI [0.12, 0.34]) and fake news as less true ($M = 0.76$ to 0.56; $\Delta = -0.20$, 95 % CI [−0.21, −0.09]). Thus, only source training had the desired outcome of increasing adults' ability to differentiate real from fake news.

Children's truth ratings varied by news type, $F(1,133) = 86.54$, $p < .001$, and assessment period, $F(1, 133) = 23.22$, $p < .001$. Unlike adults, training type had no effect, $F(1, 133) = 1.87$, $p = .174$, and did not interact with any other factor ($ps > 0.28$). Children judged real news as more true than fake news ($M = 1.35$ vs. 95; $\Delta = 0.40$, 95 % CI [0.32, 0.48]), but they judged both types of news as less true from pretest to posttest ($M = 1.23$ to 1.06; $\Delta = -0.18$, 95 % CI [−0.25, −0.10]). News type did not interact with assessment period, $F(1, 133) = 1.25$, $p = .265$, indicating that children's differentiation of fake news from real news remained consistent even with increased skepticism toward both types of news at posttest.

7.2. *Judgment accuracy*

Fig. 3 displays participants' correct judgments, i.e., judging real news as true and fake news as false. Both children and adults tended to judge fake news as false, and the accuracy of these judgments increased with training. However, only adults tended to judge real news as true, and only adults who received the source training demonstrated higher accuracy for real news following training.

We analyzed response accuracy by fitting separate binomial GLMMs for adults and children, with fixed effects of news type (fake vs. real), training type (content vs. source), assessment period (pretest vs. posttest) and their interactions. For adults, we included by-participant random intercepts and slopes for news type, assessment period, and

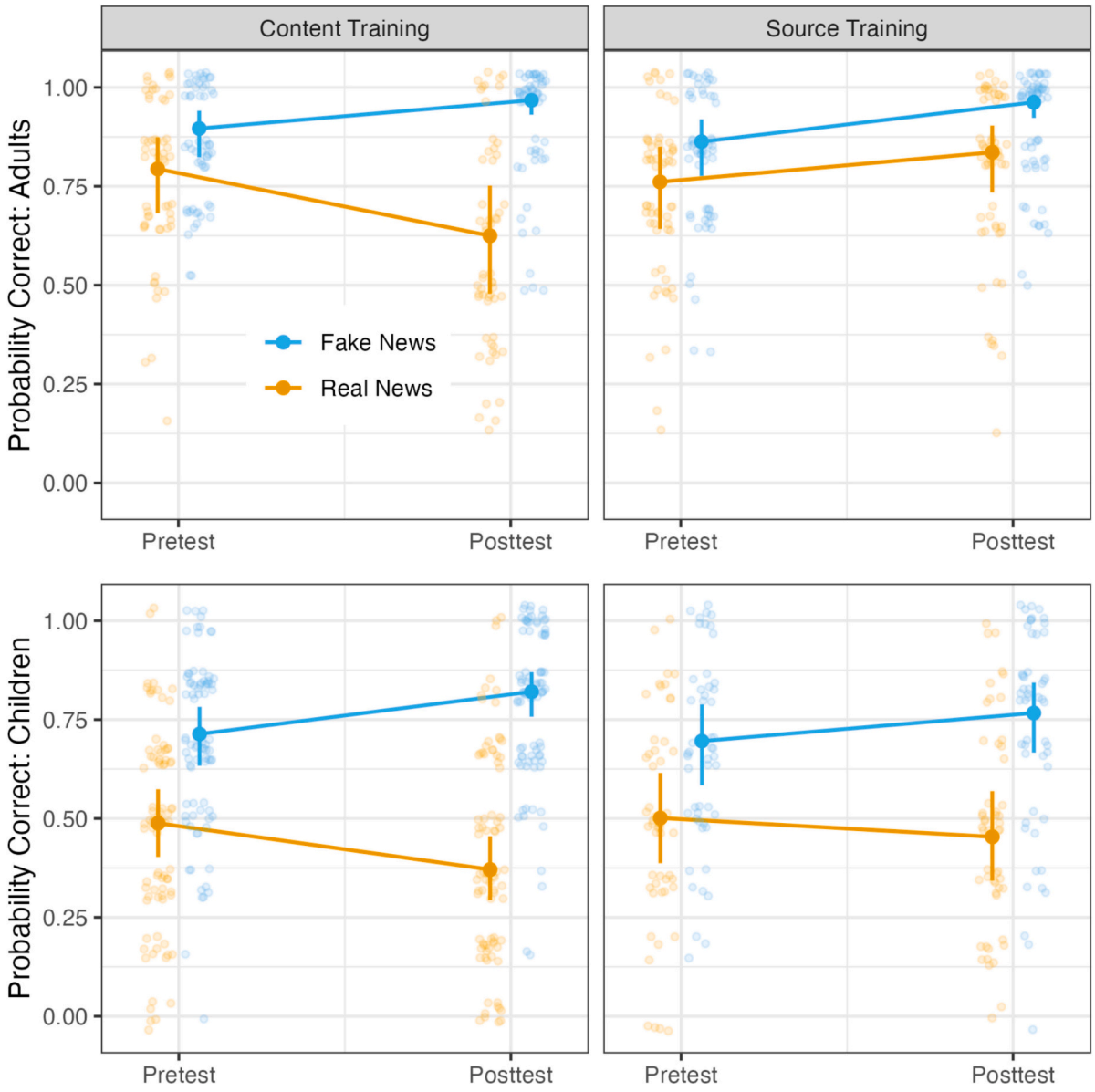

Fig. 3. Estimated probabilities of accurate judgments for adults (top) and children (bottom) before and after training. Error bars represent 95 % Cis and jittered points represent participants' raw proportion of correct judgments.

their interaction, as well as by-item random intercepts. For children, we included by-participant random intercepts and slopes for news type and by-item random intercepts and slopes for training type.

Adults' accuracy varied by news type, $\chi^2(1) = 6.96$, $p = .008$, with higher accuracy for fake news than real news (93 % vs. 76 %; OR = 4.48, 95 % CI [1.96, 10.18]), and assessment period, $\chi^2(1) = 4.65$, $p = .031$, with improved accuracy from pretest to posttest (84 % to 90 %; OR = 1.77, 95 % CI [1.26, 2.48]). These effects were qualified by a three-way interaction, $\chi^2(1) = 4.69$, $p = .030$. Adults who received content training improved accuracy for fake news from pretest to posttest (90 % to 97 %; OR = 3.45, 95 % CI [1.58, 7.56]), but their accuracy for real news declined (79 % to 62 %; OR = 0.43, 95 % CI [0.29, 0.65]). In contrast, adults who received source training improved accuracy for both fake news (86 % to 96 %; OR = 4.08, 95 % CI [2.02, 8.25]) and real news (76 % to 84 %; OR = 1.60, 95 % CI [1.04, 2.44]). Thus, source training enhanced accuracy for both news types, whereas content training increased accuracy for fake news while impairing accuracy for real news. In fact, accuracy for real news was impaired by a larger margin (17 %) than their accuracy for fake news was improved (7 %).

Children's accuracy varied by news type, $\chi^2(1) = 24.32$, $p < .001$, with higher accuracy for fake news than real news (75 % vs 45 %; OR = 3.67, 95 % CI [2.21, 6.11]). This effect was qualified by an interaction between news type and assessment period, $\chi^2(1) = 28.30$, $p < .001$. From pretest to posttest, children's accuracy for fake news improved (70 % to 79 %; OR = 1.62, 95 % CI [1.27, 2.07]), but their accuracy for real news declined (49 % to 41 %; OR = 0.71, 95 % CI [0.57, 0.89]). Children performed similarly for both types of training, and training type did not interact with news type or assessment period. In other words, children become more accurate for fake news but less accurate for real news regardless of training type.

7.3. *News differentiation scores*

To explore the effects of cognitive reflection on participants' ability to differentiate fake news from real news, we computed a news differentiation score for each participant at pretest and posttest by subtracting their mean truth rating for fake stories from their mean truth rating for real stories. The highest score one could achieve was 3.0. On average,

adults achieved a news differentiation score of 1.10 at pretest (SD = 0.52) and 1.27 at posttest (SD = 0.59), and children achieved a news differentiation score of 0.36 at pretest (SD = 0.68) and 0.44 at posttest (SD = 0.62).

We first analyzed news differentiation scores by fitting separate LMMs for adults and children, with fixed effects of CRT-D, training type (content vs. source), assessment period (pretest vs. posttest), and their interactions, along with by-participant random intercepts. Fig. 4 displays participants' news differentiation scores by CRT-D scores. These scores were positively associated with news differentiation scores for both adults, $F(1,113) = 8.62$, $p = .004$, $b = 0.09$, 95 % CI [0.03, 0.14], and children, $F(1,131) = 35.82$, $p < .001$, $b = 0.11$, 95 % CI [0.07, 0.14]. Higher cognitive reflection predicted greater differentiation of real news from fake news. Crucially, this effect was not qualified by any interactions; CRT-D's influence did not vary as a function of training type or assessment period for either adults or children ($ps > 0.16$). This suggests that cognitive reflection is a robust predictor of news differentiation.

We next examined the relation between children's age and news differentiation score. We fit an LMM with fixed effects of age, training type (content vs. source), assessment period (pretest vs. posttest), and their interactions, along with by-participant random intercepts. As can be seen in Fig. 5, age was positively associated with children's news differentiation scores, $F(1, 131) = 54.41$, $p < .001$. A one year increase in age predicted a 0.12 increase in news differentiation score, 95 % CI [0.09, 0.15]. Like CRT-D, the effect of age did not interact with any other factors ($ps > 0.23$).

As noted earlier, children's CRT-D scores were strongly correlated with their age ($r = 0.61$, $p < .001$), raising the possibility that age rather than reflection drove children's news differentiation. To investigate this possibility, we fit an LMM with fixed effects of age, CRT-D, assessment period, and their interactions, along with by-participant random intercepts. Both CRT-D, $F(1, 131) = 5.30$, $p = .023$, $b = 0.05$, 95 % CI [+0.00, 0.09], and age, $F(1, 131) = 20.44$, $p < .001$, $b = 0.09$, 95 % CI [0.05, 0.13], continued to predict children's news differentiation, indicating that cognitive reflection and age contributed independently to children's differentiation of fake news from real news.

8. Discussion

When children access the internet, they will encounter both real information and misinformation. Can they differentiate the two? Our findings suggest yes, at least to a moderate degree. The children in our study judged fake news as false more often than they judged real news as false, even though both types of news were surprising enough to merit fact-checking by an established fact checker (Snopes.com). Older children differentiated fake news from real news more reliably than younger children, and children who scored high on a test of cognitive reflection

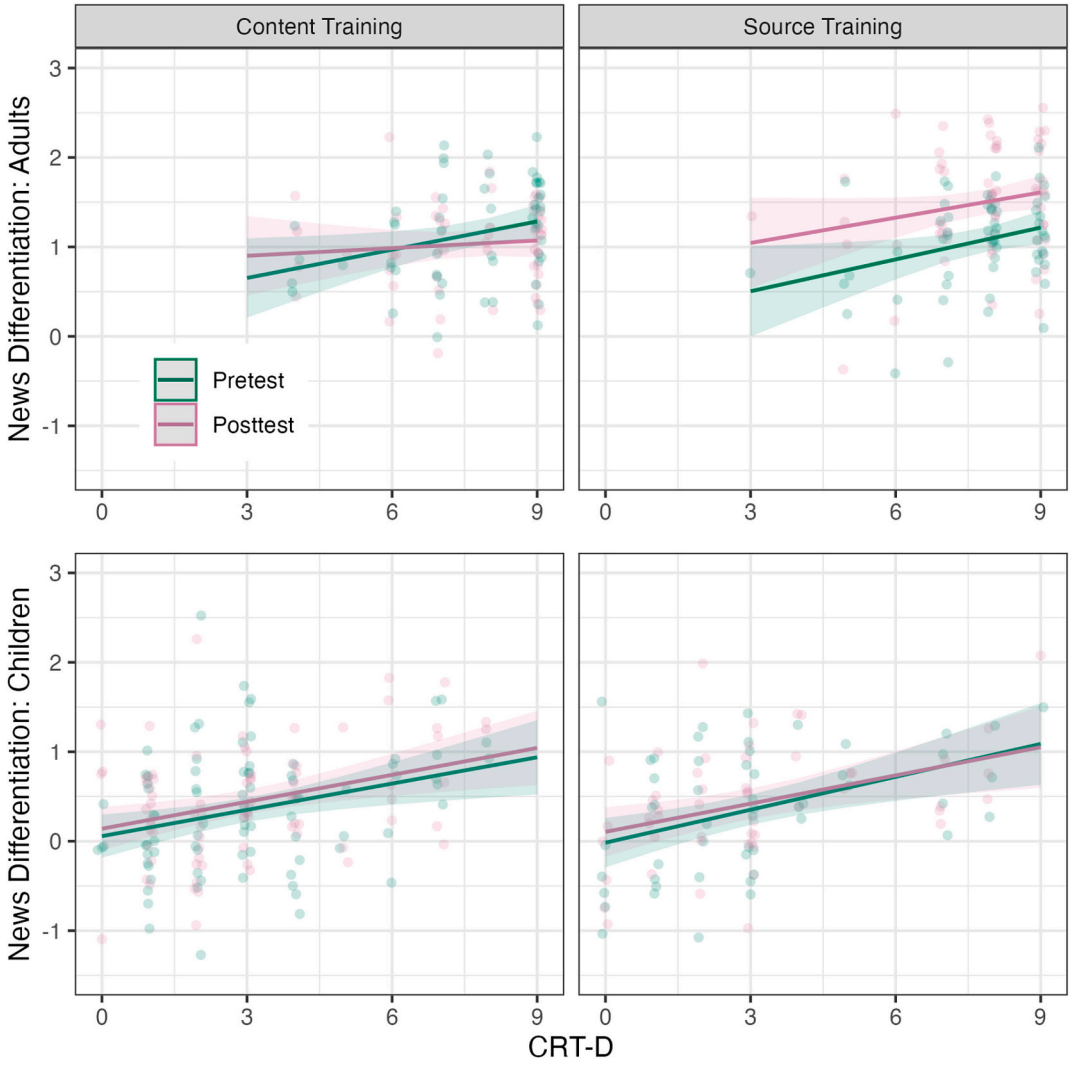

Fig. 4. Estimated news differentiation scores by CRT-D scores for adults (top) and children (bottom) before and after training. Error ribbons represent 95 % CIs and jittered points represent raw participant scores.

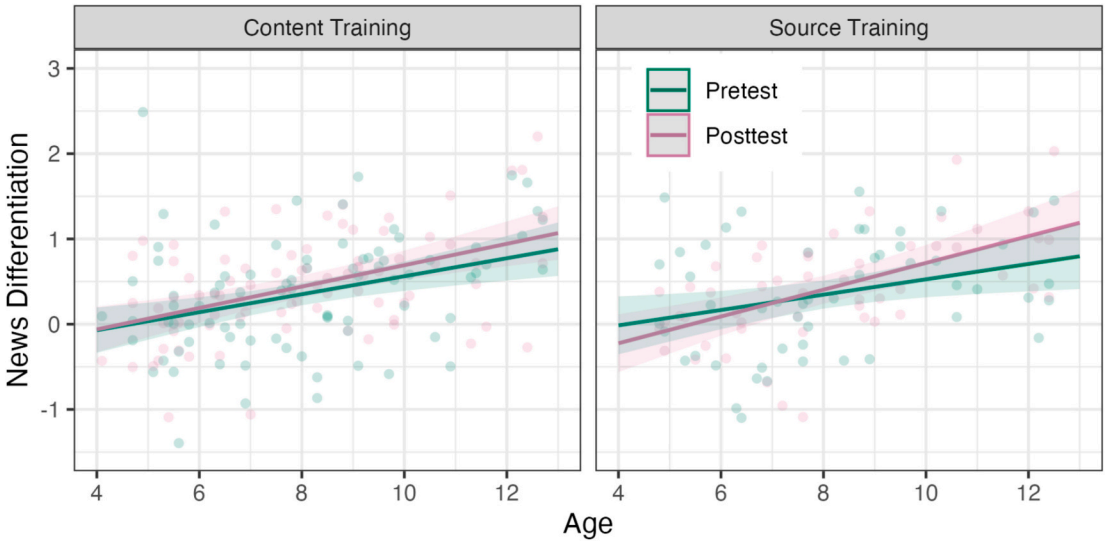

Fig. 5. Estimated news differentiation scores by children's age before and after training. Error ribbons represent 95 % CIs and jittered points represent raw participant scores.

differentiated the two types of news more reliably than those who scored low, even when controlling for age.

Children were less successful than adults at differentiating fake news from real news, but the main difference between these groups lay in their judgments for real news, not fake news. Our models of participants' accuracy indicate that, on average, fake stories were judged false 75 % of the time by children and 93 % of the time by adults (a difference of 18 %), whereas real stories were judged true 45 % of the time by children and 76 % of the time by adults (a difference of 31 %). Children and adults generally agreed that the fake stories were false but disagreed about whether the real stories were true.

This finding is surprising given the commonsense belief that children should be more susceptible to misinformation than adults. It is less surprising, however, when considering that the real stories used as stimuli were culled from the same fact-checking website as the fake stories, done to ensure that all stories presented a comparable challenge. Studies of adults' news evaluation also tend to use stimuli that are matched for surface-level plausibility, and those studies find, similar to ours, that real news is judged false more often than fake news is judged true (Pfander & Altay, 2025).

Children's rejection of real stories is also consistent with the finding that children err on the side of skepticism rather than credulity when evaluating the possibility of expectation-defying events (see Shtulman, 2023, for a review). Just as children are prone to reject the possibility of improbable events, they appear prone to reject the veracity of implausible news. Not all news is implausible, of course, but implausibility is a recurrent feature. As journalists say, "Dog bites man, who cares? Man bites dog, now that's news!" Implausible stories are not only common but also provide a stringent test of children's news evaluation. If plausibility were confounded with veracity such that all real stories were plausible and all fake stories were implausible, children could succeed at differentiating fake news from real news simply by following their gut and rejecting any story that violated their expectations; no additional reflection on a story's content or source would be necessary.

That said, children's skepticism of all news raises the question of whether concerns about children's susceptibility to fake news are unfounded. Is it a problem that children err on the side of rejecting real news rather than accepting fake news? We would argue that it is because media literacy requires not just the detection of fake news but the differentiation of fake news from real news, and many of the children in our sample failed to show any such differentiation, especially the youngest children. At pretest, 57 % of four- to five-year-olds earned a differentiation score of zero or below, as did 50 % of six- to seven-year-olds, 30 % of eight- to nine-year-olds, and 14 % of ten- to twelve-year-olds.

Lack of differentiation implies that children's judgments are shallow, based on superficial impressions rather than reasoned considerations, and shallow judgments are more likely to be overridden by social pressure, such as how often a story has been liked, how often it has been shared, or whether it was shared by a trusted friend or authority. Children's lack of differentiation, relative to adults, may be why children appear particularly susceptible to misinformation in studies that have focused directly on children's understanding of websites and web content (e.g., Einav et al., 2020; Metzger et al., 2015). The youngest children in our study may not have fully understood the task, given their limited experience with social media and online news, and their differentiation of fake news from real news could potentially be improved with additional scaffolding or instruction. Still, the task was designed to emulate the everyday challenge of detecting misinformation in an online news feed, and children will encounter this challenge as soon as they become social media users themselves.

Consistent with the idea that children's skepticism reflects shallow judgments, children's ability to differentiate fake news from real news tracked their cognitive reflection scores, indicating that children who are inclined to privilege analysis over intuition are better at identifying the elements of a news story that signal its legitimacy or illegitimacy. This finding replicates the well-documented correspondence between cognitive reflection and fake news detection in adults (Pennycook & Rand, 2021)—a correspondence also documented in the current study using the CRT-D. Even though adults performed substantially better on the CRT-D than children, individual differences in CRT-D scores predicted individual differences in news differentiation in both age groups. Reflection may thus be a critical safeguard against misinformation across the lifespan.

In contrast to reflection, instruction did not aid children's differentiation of fake news from real news. Encouraging children to think more deeply about the plausibility of a story's content or the credibility of its source made children more skeptical of fake news but it also made them more skeptical of real news, yielding no overall improvement in the accuracy of their judgments. What kind of instruction, then, might boost children's news evaluation skills?

The training effects observed among adults suggest that source-based instruction may hold more promise than content-based instruction. Adults encouraged to scrutinize source credibility demonstrated more

accurate judgments at posttest, whereas adults encouraged to scrutinize content plausibility demonstrated less accurate judgments. The latter made gains in detecting fake news but those gains were offset by losses in detecting real news—an outcome that has been observed for other content-based interventions as well (Modirrousta-Galian & Higham, 2023).

Content may not provide sufficient leverage for differentiating fake news from real news because the features that make fake news salient, such as evocativeness or controversiality, are the same features that make real events newsworthy. Source information, on the other hand, can provide critical insights into a story's origin, motivation, and production, and these factors may be better indicators of accuracy than whether the story accords with prior knowledge. Arguably, even implausible stories should be accepted as true if published by credible sources, i.e., sources that maintain rigorous standards for how they investigate and report their stories.

The reason source training was effective for adults but not children is presumably that children lack knowledge of how news is produced and by whom (Ku et al., 2019). Future research could bridge this gap with instruction about news production, though it is an open question whether children would benefit from general information about journalistic standards or would need to learn about specific news outlets that maintain those standards. The latter may be more helpful when confronted with social-media-style posts that limit source information to a URL, but this approach would be contentious given the politics of today's media landscape (Gallup, 2018). Another approach is to highlight the unreliability of unreliable sources through guided exploration. This technique has been shown to increase children's attentiveness to whether sources cite evidence (Orticio, Meyer, & Kidd, 2024) and decrease their trust in sources that make blatantly false claims (Tong, Danovitch, Wang, & Wang, 2025).

9. Limitations & future directions

In many studies of fake news detection, participants are asked to make two judgments: whether a story is accurate and whether they would share that story with others on social media. In the present study, we did not ask children whether they would share the story because children do not yet have social media accounts and would not be experienced making such judgments. Still, children do share information offline. Studies of how children share information in pedagogical contexts, like teaching new facts to a peer, find that children privilege true information over false or ambiguous information (Pueschel, Ibrahim, Franklin, Skinner, & Moll, 2023), yet children's sharing decisions are not driven solely by truth (Qiu, Park, Vite, Patall and Moll, 2025). Children preferentially share information that their audience will find useful (Danovitch, 2020), novel (Saylor, Baird, & Gallerani, 2006), or provocative (Qiu, Ipek, & Moll, 2024), similar to the kinds of information that adults share on social media (Chen, Pennycook, & Rand, 2023). Future research could measure children's sharing intentions alongside their accuracy judgments to determine how these assessments are related from the start of online activity, as children begin spreading news in addition to consuming it.

Future research might also explore other means of teaching children to avoid online misinformation. Our teaching interventions encouraged children to critically analyze specific features of a story, but an alternative approach is encouraging them to *critically ignore* stories with questionable content (Kozyreva, Wineburg, Lewandowsky, & Hertwig, 2023). Fake news is designed to capture attention and elicit strong reactions, so the more we engage with fake news the more we has succumbed to the intentions of those who created it. The normative strategy for dealing with questionable content, adopted by professional fact checkers, is to disengage from that content and seek verification from other, external sources (Wineburg & McGrew, 2019). This strategy, known as lateral reading, has proven effective at helping adolescents identify online misinformation, as noted above.

We did not broach the topic of lateral reading in the current study because our participants were generally too young to carry it out, but future research could introduce elementary schoolers to a scaled-down version of lateral reading that stresses the fundamentals of this approach without also requiring search skills. It should be noted, however, that disengaging from fake news and other dubious web content requires identifying such content as dubious in the first place. Differentiating real information from misinformation is a prerequisite for ignoring the latter. Many social media posts do not include enough information for viewers to make a sound determination of accuracy, thereby necessitating an external search, but viewers must be able to identify cues to misinformation to initiate any search at all. Children's awareness of such cues is thus a worthy topic of investigation even if the ultimate goal of media literacy is to foster disengagement rather than deeper engagement.

Related to this concern are concerns about what even counts as misinformation. Some critics have argued that fake news detection paradigms have limited real-world applicability because fake news is not a discrete category of web content (Adams, Osman, Bechlivanidis, & Meder, 2023), nor is it as prevalent as commonly believed (Altay, Berriche, & Acerbi, 2023). Likewise, fake news impacts some segments of the public more than others (Brashier, 2024), and its impact may be less significant than the impact of true but misleading news (Allen, Watts, & Rand, 2024). Should researchers use fake news as stimuli if its prevalence and impact may be overblown?

We would argue that fake news and its detection has instrumental value. While fake news may not be as prevalent as real news, it is present on the internet nonetheless, and internet users will likely encounter the most viral strains of such misinformation. Every story used in the current study circulated on the internet far enough and wide enough for professional fact checkers to take note. And while the impact of a specific article is difficult to gauge, the fake-news detection paradigm was not designed to assess impact. Rather, it was designed to measure participants' ability to *differentiate* fake news from real news and how that differentiation varies with dispositional and situational factors.

This skill is foundational to more advanced forms of media literacy, and studying its emergence provides valuable insights into when and how a more nuanced understanding of today's digital landscape can be acquired. Indeed, future research could explore the emergence of news evaluation skills in relation to how children understand the digital landscape. As that landscape shifts in the wake of AI-generated content, children will likely encounter more warnings about the internet and its veracity, and those warnings may affect their willingness to accept online information as true, even before they spend much time online themselves.

10. Conclusion

Children, like adults, are regularly on the internet and may thus be exposed to online misinformation. Our study indicates that children are not as skilled as adults at differentiating misinformation from real information but do have the capacity to do so, and this capacity is enhanced by a disposition to reflect on one's own cognition. Instructing children to scrutinize the plausibility of news content or the credibility of news sources increases their skepticism of online news but does not increase the accuracy of their truth judgments. Instructing adults to scrutinize the credibility of news sources does increase accuracy and may prove effective for children as well if accompanied by additional instruction on news production. Detecting misinformation is not the only skill that children need to protect themselves against digital manipulation, but it is a critical first step for engaging other tools in the toolkit that constitutes sound media literacy.

CRediT authorship contribution statement

Andrew Shtulman: Writing – original draft, Supervision, Project

administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Lucy Stoll:** Investigation, Data curation, Conceptualization. **Lesly Sabroso:** Investigation, Data curation, Conceptualization. **Andrew G. Young:** Methodology, Investigation, Formal analysis, Conceptualization.

Declaration of competing interest

The authors confirm that they have no affiliation with or involvement in any organization with interests (financial or otherwise) in the reported research.

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Data availability

All data and analyses are available at the Open Science Framework: https://osf.io/wshkc/?view_only=fb222a78d31c462382236a6c56769642

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