



Contents lists available at ScienceDirect

# Journal of Experimental Child Psychology

journal homepage: [www.elsevier.com/locate/jecp](http://www.elsevier.com/locate/jecp)



## Advanced theory of mind and children's prosocial lie-telling in middle childhood: A training study

Qiyang Gao<sup>a</sup>, Peiyao Chen<sup>b</sup>, Qianyao Huang<sup>a</sup>, Zhenlin Wang<sup>c,\*</sup>

<sup>a</sup>Shaoxing University, Shaoxing, Zhejiang 312010, China

<sup>b</sup>South China Normal University, Guangzhou, Guangdong 510631, China

<sup>c</sup>Massey University, Palmerston North 4442, New Zealand



### ARTICLE INFO

#### Article history:

Received 11 January 2024

Revised 28 May 2024

Available online 20 July 2024

#### Keywords:

Advanced theory of mind

Middle childhood

Prosocial lie-telling

Training

Fade-out

Conversation-based approach

### ABSTRACT

Children's advanced theory of mind (AToM) is concurrently associated with their prosocial lie-telling. However, the causal link between AToM and prosocial lie-telling has not yet been demonstrated. To address this gap, the current study adopted a training paradigm and investigated the role of AToM in children's prosocial lie-telling in middle childhood. A total of 66 9- and 10-year-old children who did not demonstrate any prosocial lie-telling in a disappointment gift paradigm at the baseline were recruited and randomly assigned to either the experimental group ( $n = 32$ ) or an active control group ( $n = 34$ ). The experimental group underwent a conversation-based training program of four sessions. The results showed significantly greater gains in AToM at the posttest for the experimental group children compared with the control group children, controlling for family socioeconomic status, children's literacy score, working memory, and inhibition. More important, the experimental group children were more likely to tell prosocial lies than the control group, even after controlling for the pretest AToM and other covariates. However, the training effects faded at the 6-month follow-up test after the training's completion. These findings provide the first evidence for the causal role of AToM in the development of prosocial lie-telling in middle childhood. The fade-out effect is discussed in the context of educational interventions.

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\* Corresponding author.

E-mail address: [z.wang5@massey.ac.nz](mailto:z.wang5@massey.ac.nz) (Z. Wang).

## Introduction

Theory of mind (ToM), the ability to understand one's own and other people's mental states (Wellman, 2014), is associated with multiple aspects of children's social functioning, including peer popularity (Slaughter et al., 2015), prosocial behavior (Imuta et al., 2016), and lie-telling (Ding et al., 2015; Lee & Imuta, 2021; Sai et al., 2021). In a groundbreaking study, Ding and colleagues (2015) reported that ToM training caused previously honest children to lie about the location of a sticker in a hide-and-seek task to "fool" an experimenter and maximize their own gain. Indeed, ToM as a cognitive ability could function as a double-edged sword in social exchanges to either facilitate prosocial behaviors or enable calculative Machiavellianism (Repacholi et al., 2003). Two recent meta-analyses (Lee & Imuta, 2021; Sai et al., 2021) demonstrated that ToM is positively associated with children's lying, albeit with small effect sizes. Lee & Imuta (2021) further showed that ToM is associated with both prosocial lies and antisocial lies with comparable effect sizes. However, the studies reviewed in the meta-analyses were predominately correlational. Little is known about the causal relation between ToM and prosocial lie-telling (Lee & Imuta, 2021). Given ToM's association with children's prosocial behavior (Imuta et al., 2016), does having a more advanced ToM help children to tell prosocial lies with the intention to benefit or protect others? To address this gap, the current study adopted a conversation-based training approach to examine the causal link between advanced ToM (AToM) and prosocial lie-telling in school-aged children.

### *Prosocial lie-telling and its relation with ToM*

Prosocial lies are lies intended to benefit others (Levine & Lupoli, 2022). Spontaneous prosocial lie-telling appears early in life and becomes increasingly sophisticated with age. Whereas self-serving lies appear as early as 2 years of age (Lee, 2013), Talwar and colleagues (2007) found that children as young as 3 years would tell prosocial lies to avoid upsetting the experimenter who selected an undesirable gift for them. A more recent review reported that prosocial lie-telling appears from 4 years of age for most children (Demedardi & Monnier, 2019). By primary school age, children would be better able to maintain their lies with subsequent cover-up statements (Popliger et al., 2011; Williams et al., 2016). Popliger and colleagues (2011) asked children who received a disappointing gift whether they liked the gift and what they planned to do with it to examine whether they could generate plausible cover-up statements. Compared with preschool children, school-aged children were more likely to conceal their disappointment and come up with a plausible cover-up such as "I like how soft it is." This finding indicated older children's maturity in telling and maintaining their prosocial lies.

The paradox of prosocial lie-telling is reflected in the conflict between the desire to maintain honesty and that to help others (Levine & Lupoli, 2022). Whereas younger children tended to see prosocial lies more negatively, older children and adolescents were more inclined to make increasingly positive evaluations of prosocial lie-telling (Cheung et al., 2015; Fu et al., 2010; Williams et al., 2016). School-aged children acknowledged the positive value of being polite and referred to their prosocial motivations when asked to justify their prosocial lies, such as avoiding hurting the feelings of the gift-giver (Xu et al., 2010).

Lie-telling has been dubbed as ToM in action (Lee, 2013). A person with a ToM understands that other people have mental states and processes such as intentions, desires, emotions, and beliefs that are distinctive from his or her own, and these mental states and processes govern their behaviors (Wellman, 2014). Lee (2013) argued that ToM is essential in lie-telling because individuals must understand their own mental state and that of their audience in order to deceive. Whereas antisocial lie-telling is predominately associated with children's first-order false belief understanding, the ability to attribute false belief to others (e.g., Ding et al., 2015; Ma et al., 2015; Talwar & Lee, 2008, but see Wang et al., 2017, for counter-evidence), prosocial lie-telling requires the liar to be aware of the recipients' mental states, predict their responses to the prosocial lies, and evaluate whether or not they would benefit from the comfort and emotional support of the prosocial lies. As such, prosocial

lie-telling appears later in development and involves more advanced cognitive resources and a higher level of social understanding (Williams et al., 2016).

Like antisocial lie-telling, prosocial lie-telling instills a false belief in others. Studies evaluating the association between prosocial lie-telling and ToM predominately focused on school-aged children and adopted second-order false belief understanding, the ability to appreciate that it is possible to have a false belief about others' belief, as a ToM indicator (Broomfield et al., 2002; Williams et al., 2016). Using a disappointing gift paradigm, Williams and colleagues (2016) found that primary school children who performed better in second-order false belief understanding tasks were better at maintaining prosocial lies, although the link between second-order false belief understanding and prosocial lie-telling was not significant.

Unlike antisocial lie-telling, however, prosocial lie-telling involves an emotional understanding given that its purpose is to protect the interlocutor's feelings (Warneken & Orlins, 2015). There is evidence that children's prosocial lie-telling was associated with their concurrent emotional understanding but not with empathy (Demedardi et al., 2021). In a training study, Thiede and colleagues (2023) demonstrated that children's enhanced empathy through intervention did not transfer to more prosocial lies. Nagar and colleagues (2020) further demonstrated that parents' reports of child perspective-taking, such as understanding why others were upset, predicted school-aged children's prosocial lie-telling. Taken together, it seems that empathy, the shared emotional experience triggered by witnessing others' distress (Nagar et al., 2020), is not predictive of children's prosocial lie-telling. Instead, the representational understanding of the interlocutor's mental states and processes, both cognitive and affective, appears to be the underlying mechanism of prosocial lie-telling.

Advanced theory of mind refers to complex mental state understanding abilities beyond early childhood (Osterhaus & Bosacki, 2022). Of particular interest here is the ability to interpret nonliteral statements in the context of social narratives such as irony, sarcasm, metaphor, and lie-telling (e.g., Happé, 1994). One of the AToM measures, the Strange Stories task (Happé, 1994), assesses children's ability to interpret the story characters' seemingly "strange" actions using mental state narratives in middle childhood. This task mimics the real-life social exchanges that require an AToM including prosocial lie-telling, hence providing a pivoting point for training.

### *Conversation-based AToM training in middle childhood*

The social constructivist's account of ToM development asserts that the quality and quantity of social input are pivotal to the development of children's mental state understanding (Hughes & Devine, 2015). Current ToM training studies mainly focus on preschool-aged children and those with special needs (Begeer et al., 2015; Cheung et al., 2015; Ding et al., 2015; Stewart et al., 2019). Nevertheless, several conversation-based ToM training studies have shown promising results in typically developing school-aged children (Gao et al., 2019; Lecce & Bianco, 2018; Lecce et al., 2014). Indeed, a meta-analysis (Hofmann et al., 2016) showed that ToM training programs that create rich mental state conversation contexts were effective with a large effect size regardless of the participants' age.

Lecce and colleagues' conversation-based ToM training studies (Lecce & Bianco, 2018; Lecce et al., 2014) were conducted in a classroom context with children aged 9 and 10 years using the Strange Stories (Happé, 1994) as training materials. Children were engaged in discussions led by researchers about the mental states of the story characters and were given language exercises related to mental state talks. Lecce and colleagues found that children's AToM measured with the Strange Stories improved significantly after four training sessions, compared with a closely matched active control group, and the training effect remained significant at a follow-up test 2 months later. Bianco and colleagues (2016) further demonstrated that the mental-state-based conversation showed near-transfer effects not only in ToM measures such as the Strange Stories task practiced during the training but also in far-transfer tasks such as the Triangle Task (White et al., 2011), for which the children had received no direct training. These findings indicated that conversation-based training in a classroom setting can effectively improve children's AToM.

The extent to which the training effect can be sustained after the training sessions end is key to developmental and educational intervention studies (Bailey et al., 2020). Bailey and colleagues (2020) reviewed a wide range of educational interventions and concluded that fade-out is a

substantial phenomenon. However, they also noted that long-term follow-up assessments of the most rigorously implemented interventions revealed later emergence of the relevant skills and recommended intervention studies to include longer follow-up periods. [Ding and colleagues \(2015\)](#) measured children's self-serving lie-telling behaviors with a hide-and-seek task repeatedly immediately after the training sessions for 6 consecutive days. They found that both the experimental group and control group children showed continued growth in their lie-telling behaviors, with the experimental group steadily outperforming the control group throughout the period. Taken together with [Lecce and colleagues' \(2014\)](#) finding that their experimental group still outperformed the control group on the Strange Stories task 2 months after the training ended, it is reasonable to expect that the conversation-based training could have a sustained effect on children's mental state understanding and strategic social behaviors like prosocial lie-telling. However, there is no evidence yet on the long-term ToM training effect beyond 2 months. Does the training effect fade out over time, or could it be sustained over an extended period? Following [Bailey and colleagues' \(2020\)](#) recommendation, a longer interval between the completion of the training sessions and the follow-up test is needed to reveal the long-term effectiveness of the conversation-based training on children's mental state understating and prosocial lie-telling.

### *The current study*

The first aim of the study was to replicate the AToM training effect using an adapted version of the conversation-based training program ([Lecce & Bianco, 2018](#); [Lecce et al., 2014](#)). The second aim was to investigate the causal role of AToM in school-aged children's prosocial lie-telling behavior. It was hypothesized that AToM training would increase not only children's AToM understanding but also their prosocial lie-telling ability. The third aim was to extend the time interval between the training sessions and the follow-up test to examine the long-term effectiveness of conversation-based training on children's AToM and prosocial lie-telling. The Strange Stories task ([Happé, 1994](#)) was used to measure AToM because it provides everyday social situations for children to apply their AToM ([Shahrivar et al., 2017](#)). A disappointing gift paradigm ([Broomfield et al., 2002](#); [Williams et al., 2016](#)) was adopted to measure children's prosocial lie-telling behavior. The current study statistically controlled for children's working memory and inhibitory control because previous research found that executive function moderates the association between ToM and lie-telling ([Sai et al., 2021](#)). The participants' age, verbal ability (indicated by Chinese literacy test scores), and their family socioeconomic status (SES) were also included as control variables given their associations with ToM ([Tompkins, 2015](#); [Tompkins et al., 2017](#)). Children's AToM and prosocial lie-telling were measured three times: first before the training sessions commenced to establish a baseline, then 2 weeks after the training sessions ended to examine the training effect, and lastly 6 months after the training to examine the long-term sustainability of the training effect.

## **Method**

### *Participants*

A power analysis was conducted to determine the required sample size using G\*Power 3.1 software, as outlined by [Faul et al. \(2007\)](#). To identify an effect size of  $f = .25$  with a significance level of  $\alpha$  set at .01 and statistical power ( $1 - \beta$ ) of .80, a minimum of 40 participants was deemed necessary for this study. The current study recruited 115 third- and fourth-grade children from a public primary school representing a diverse socioeconomic background in Shaoxing, China. Of these children, 35 were excluded from the study because they passed the prosocial lie-telling test in the pretest. In addition, 14 children were excluded due to training incompleteness or the posttest. The final sample consisted of 66 children. They were randomly assigned to either the experimental group ( $n = 32$ ;  $M_{\text{age}} = 9.83$  years,  $SD = 0.60$ ; 19 boys and 13 girls) or the control group ( $n = 34$ ;  $M_{\text{age}} = 9.83$  years,  $SD = 0.56$ ; 21 boys and 13 girls). All children were native speakers of Mandarin Chinese.

## Procedure

The study was approved by a local university's research ethics committee. Informed consent was received from the children's parents or legal guardians before the commencement of the study. Classroom teachers provided individual students' latest scores on a Chinese literacy test conducted right before the pretest on a scale of 100. All children completed seven parts of the study, including a pretest, four story reading sessions, a posttest 2 weeks after the story reading sessions, and a follow-up test 6 months after the story reading sessions. Two trained research assistants administered the pretest, the posttest, and the follow-up test in the school. At the pretest, children completed a battery of tasks in a semi-random order, including the Strange Stories task (White et al., 2009), the disappointing gift paradigm (Saarni, 1984; Williams, et al., 2016), two executive function tasks (the digit span and Stroop tasks), and the Family Affluence Scale. The pretest lasted 40 to 45 min. At the posttest and follow-up test, all children completed the Strange Stories task and the disappointing gift paradigm in random order in about 20 min.

## Training

Trained preservice student teachers who were not involved in the testing sessions led the story reading sessions for the experimental group and control group children. Only those children who did not lie during the disappointing gift task in the pretest entered the training stage. Following Lecce and colleagues' protocol (Lecce & Bianco, 2018; Lecce et al., 2014), the training materials for the experimental group were adapted from the Strange Stories task (White et al., 2009). The stories used for both the experimental group and the control group are presented in the Appendix. Participants in the experimental group read stories about misunderstanding, persuasion, double bluff, and joke. We replaced the white lie story from the Strange Stories task (White et al., 2009) with a joke story to avoid potential contamination due to the similarity between the white lie story and the current prosocial lie-telling task (Talwar & Crossman, 2011). All children assigned to the experimental group participated in the training sessions together as a single group in a separate classroom led by one student teacher during school days. Each session lasted 40 min. Children participated in one session per week for 4 consecutive weeks. The same arrangement was carried out for the control group children, led by another student teacher.

Each training session consisted of three steps for the experimental group: strange story comprehension and discussion, story composition, and a mental state verbs exercise. In a classroom setting, a trained preservice student teacher guided children to read one of the strange stories and asked a set of questions about the story related to (a) the mental states of the characters, (b) one character's understanding of another character's mental state (second-order false belief), (c) mental states based on social behavior, and (d) what the character can do or say to change the mental state of another character (to emphasize that mental states are dynamic). Children were asked to write their answers individually and discuss them in class. The student teacher gave oral feedback to each student's answers and then guided children to compare and contrast the similarities and differences in the two characters' mental states and summarized the key theme of the story. To ensure that all children were actively involved in the training, the student teacher engaged in one-on-one conversations with individual children in each session. The second step of the training sessions required individual children to compose a story of their own similar to the one they read based on their real-life experiences, focusing on the characters' beliefs and opinions. The last step was a mental state verb exercise. Children were presented with sentences extracted from the story and asked to choose a synonym out of four options to replace the original mental state verb in the sentence without compromising its meaning. Again, individual children wrote down their answers and discussed them in class, and the student teacher gave oral feedback.

The control group was given stories similar in format to those used in the experimental group but focusing on reasoning about physical states. Like the experimental group, a trained preservice student teacher guided children to read the stories, followed by a series of questions. The first three questions were about the factual details of the story. The last question asked children to explain the physical

events mentioned in the story. These questions were discussed extensively in the class. The control group did not engage in story composition or verb exercises.

### Measures

#### Family affluence scale

The Family Affluence Scale (Boyce et al., 2006) was adopted to assess family SES. Children completed a short questionnaire that included questions on the number of cars owned by the family (range = 0–2), whether they had their own room (dummy variable, 0–1), the number of computers at home (range = 0–3), and the number of times they went on a holiday during the past year (range = 0–3). The scores were aggregated into an overall index of family SES (range = 0–9).

#### Digit span task

Working memory was assessed using a digit span task presented in E-Prime software (Psychology Software Tools, Pittsburgh, PA, USA) on a laptop computer. Participants were required to repeat a series of digits presented at a rate of four digits per second (200-ms presentation, 50-ms interval) with mouse clicks. Participants began with three practice trials of a two-digit list. The test stage included three trials of each list length from three to nine digits. If participants recalled two of the three trials from the three-digit list correctly, they were presented with the next list. This continued until participants either correctly recalled at least two trials of the nine-digit list or failed to correctly recall two trials of a given list, at which point the testing ended. The final score was the total number of correct trials recalled (Unsworth et al., 2014).

#### Stroop task

The Stroop task (Unsworth & Spillers, 2010) was adopted to assess children's inhibition. The task was presented in E-Prime on a laptop computer. In 486 trials, participants needed to indicate the color hue in which a word was printed as quickly as possible (e.g., "BLUE" printed in red ink). Blue, green, and red colored words were used. The coloring and the word were congruent in 66% of the trials. Each color and word appeared with equal frequency. Participants responded by pressing one of three colored stickers that were affixed to the keypad keys 1 (green), 2 (blue), and 3 (red). Incorrect responses were followed by a beep heard via headphones. Children were given a self-paced rest break after every 162 trials. The final score was the response time differences between the congruent and incongruent trials.

#### Strange stories task

The Strange Stories task (Happé, 1994; White et al., 2009) is considered the best test to measure AToM development in middle childhood based on a systematic review (Osterhaus & Bosacki, 2022). Four stories from this task were adopted in the current study: double bluff, persuasion, misunderstanding, and joke. The current study replaced the white lie story in the training sessions used by Lecce and colleagues (Lecce & Bianco, 2018; Lecce et al., 2014) with a joke story to avoid the close resemblance between the training stories and the disappointing gift task. The task was administered with a paper-and-pencil version in a group setting. Participants read the stories and answered questions in writing to explain the behaviors of the story characters. There was no time limit. Answers were evaluated using a 3-point scale: 0 for an incorrect answer, 1 for a partially correct answer that specified facts only but not mental states, and 2 for a correct answer referring to the characters' mental states. The total Strange Stories scores ranged from 0 to 8. Interrater reliability was established by having two independent raters code all answers at each time point ( $\kappa = .93$  at the pretest,  $\kappa = .83$  at the posttest, and  $\kappa = .82$  at the follow-up test). Disagreements were resolved through discussion between the raters. Although the integrity of the stories was kept intact, the characters and objects in the stories were altered in the posttest and follow-up test to minimize the repeated-measure effect.

#### Disappointing gift paradigm

The disappointing gift paradigm was adopted to assess children's prosocial lie-telling (Saarni, 1984; Williams et al., 2016). Two trained research assistants conducted the experiments with individual

participants in a quiet classroom in school. While the first research assistant (RA1) started the task with the participant in the room, the second research assistant (RA2) waited outside. RA1 first presented a set of items to the participant, including the desirable ones like comic books, snacks, and rag dolls, as well as the disappointing items, including a garbage bag and a piece of crumpled paper. The selection of these items was based on a separate pilot study with a group of 40 children. The probability of getting any specific disappointing gift was the same, and each child received a different disappointing gift in the pretest, posttest, and follow-up test. The child was instructed to rank the gifts in order of preference by assigning scores ranging from 0 to 5 points. RA1 then exited the room, and RA2 entered to administer the cognitive tasks. After these tasks, the child received one of the disappointing gifts concealed in a box. RA2 told the child, "This is the gift I personally selected for you." She then instructed the child to open the box before leaving the room briefly. Upon returning, RA2 assured the child that anything he or she said would be confidential and inquired, "How do you like the gift?" The child either responded truthfully (e.g., "No, I don't like it") or told a prosocial lie (e.g., "Yes, I like it"). To assess the child's ability to maintain the prosocial lie and offer plausible explanations, RA2 asked further questions such as "What do you like about your gift?" and "What do you plan to do with it?" Subsequently, RA2 exited the room and RA1 re-entered. RA1 asked the child, "How do you like your gift?" and "Would you like to trade it for a different one?" All children responded to RA1 that they preferred a different one.

Children who told both RAs that they did not like the gift were categorized as truth-tellers. Those who informed RA2 of their liking for the disappointing gift but later expressed dissatisfaction to RA1 were coded as prosocial lie-tellers. Among the lie-tellers, responses to RA2's follow-up questions were coded as either implausible explanations (e.g., "I don't know") or plausible explanations (e.g., "Someone gave it to me"). An implausible explanation indicates an inability to sustain the lie, whereas a plausible explanation demonstrates successful control over semantic leakage associated with the previously told lie. Children who were categorized as truth-tellers received 0 points, and those who were categorized as prosocial lie-tellers received 1 point. In addition, those who gave implausible explanations for the follow-up questions received 0 points, and those who provided plausible explanations received 1 point. Adding the two codes together, the prosocial lie-telling scores ranged from 0 to 2 points. Two independent raters coded all responses to the semantic leakage control questions, achieving an inter-coder reliability of 96%. Any discrepancies were resolved through discussion.

**Results**

*Descriptive statistics and correlations*

Descriptive statistics and correlations for the key variables in the two groups are shown in Table 1 and Table 2. A series of preliminary analyses showed that at the pretest the two groups did not show significant differences in age,  $t(64) = -0.030, p = .976, 95\%$  confidence interval (CI)  $[-0.29, 0.28]$ ;

**Table 1**  
Descriptive statistics of key variables at three time points.

	Pretest		Posttest		Follow-up	
	Experimental group	Control group	Experimental group	Control group	Experimental group	Control group
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
Family SES	6.41 (2.3)	5.76 (2.1)				
Chinese literacy	89.64 (6.2)	90.10 (5.6)				
Working memory	40.69 (22.8)	51.74 (23.4)				
Inhibition	64.28 (180.6)	106.12 (128.1)				
AToM	3.88 (1.5)	3.88 (1.1)	6.47 (1.3)	3.52 (1.2)	3.81 (1.6)	4.12 (1.6)
Prosocial lie-telling	0 (0)	0 (0)	0.81 (1.0)	0.21 (0.6)	0.38 (0.8)	0.44 (0.8)

Note. SES, socioeconomic status; AToM, advanced theory of mind.

**Table 2**  
Bivariate correlations among variables at three time points.

	1	2	3	4	5	6	7	8	9	10	11
1. Age	–										
2. SES	–.205	–									
3. Chinese	–.594**	.139	–								
4. WM	.165	–.081	.017	–							
5. Inhibition	.149	–.130	.005	.188	–						
6. AToM pre	–.003	.110	.245*	.191	–.036	–					
7. PL pre	–	–	–	–	–	–	–				
8. AToM post	.115	–.014	.011	0	–.161	.174	–	–			
9. PL post	.057	–.170	.05	–.114	–.026	.069	–	.345**	–		
10. AToM follow-up	.084	.053	.206	.174	–.185	.225	–	.160	–.046	–	
11. PL follow-up	.009	.125	.061	–.135	.004	.049	–	–.028	–.081	–.186	–

Note. SES, socioeconomic status; WM, working memory; AToM, advanced theory of mind; PL, prosocial lie-telling.

\*  $p < .05$

\*\*  $p < .01$ .

family SES,  $t(64) = 1.192, p = .238, 95\% \text{ CI} [-0.43, 1.72]$ ; Chinese literacy,  $t(64) = -0.319, p = .751, 95\% \text{ confidence interval (CI)} [-3.36, 2.43]$ ; inhibition,  $t(64) = -1.091, p = .279, 95\% \text{ CI} [-118.46, 34.78]$ ; working memory,  $t(64) = -1.943, p = .056, 95\% \text{ CI} [-22.41, 0.31]$ ; or AToM,  $t(64) = -0.022, p = .982, 95\% \text{ CI} [-0.66, 0.65]$ .

*Training effects*

To determine the effect of the conversation-based AToM training on children’s performance on the Strange Stories task, a mixed-model analysis of covariance was conducted on the Strange Stories task scores, with group membership (experimental group vs. control group) as a between-participants factor, time (pretest vs. posttest vs. follow-up test) as a repeated-measure factor, and family SES, Chinese literacy, working memory, and inhibition as covariates. The main effect of time was not significant ( $p = .233$ ). The main effect of group membership,  $F(1, 60) = 17.168, p < .001, \eta^2 = .222$ , and the interaction effect between time and group membership,  $F(2, 120) = 37.682, p < .001, \eta^2 = .386$ , were significant. In the post hoc analysis, the AToM scores were not significantly different between the experimental group and control group in the pretest and follow-up test ( $ps > .548$ ); however, the difference between the two groups was significant in the posttest,  $t(64) = 10.416, p < .001$ . Moreover, the AToM scores for the experimental group improved significantly from the pretest to the posttest,  $t(31) = 9.612, p < .001$ , and decreased significantly from the posttest to the follow-up test,  $t(31) = -9.366, p < .001$ . On the contrary, the AToM scores for the control group showed no difference between the pretest and the posttest or between the pretest and the follow-up test ( $ps > .132$ ). These results indicated that the training significantly enhanced the experimental group children’s AToM performance at the posttest, but the effect faded away over the 6-month interval. The results are illustrated in Fig. 1.

To investigate whether AToM training caused the change in children’s prosocial lie-telling, a mixed-model analysis of covariance on the prosocial lie-telling scores was conducted with time (pretest vs. posttest vs. follow-up test) as a repeated-measure factor, group membership (experimental group vs. control group) as the between-participants factor, controlling for the pretest AToM, family SES, Chinese literacy, working memory, and inhibition. The results showed a significant interaction effect between time and group membership,  $F(1.551, 93.037) = 6.364, p < .01, \eta^2 = .096$ , but no main effects of time or group membership were observed ( $ps > .071$ ). The post hoc analysis showed that there were no significant differences between the prosocial lie-telling scores of the experimental group and the control group in the pretest and the follow-up test ( $ps > .495$ ), but a significant difference was observed between the two groups in the posttest,  $t(31) = 3.236, p < .01$ . Moreover, the prosocial lie-telling scores of the experimental group children improved significantly from the

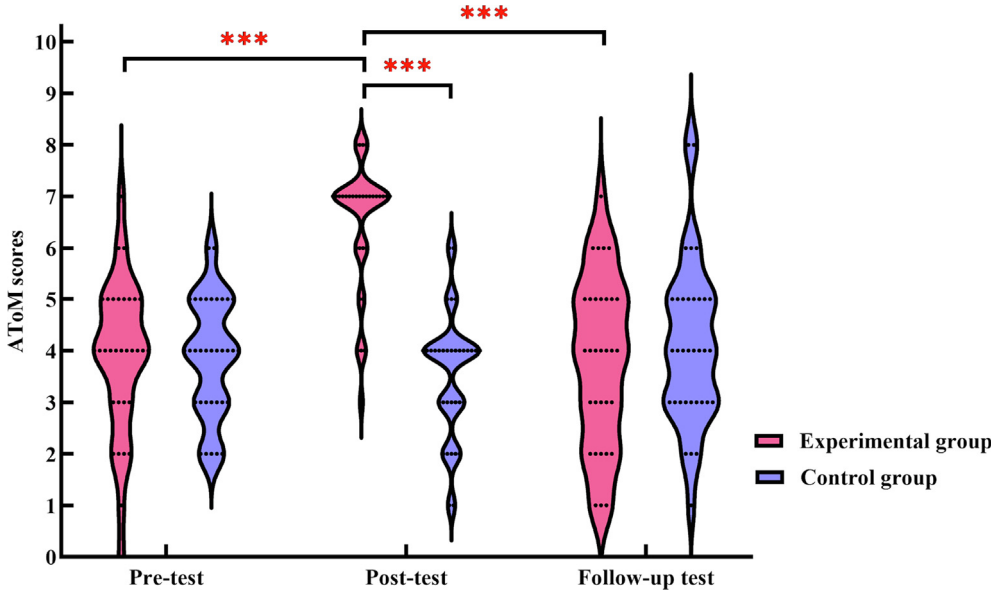


Fig. 1. Advanced theory of mind (AToM) scores of the pretest, posttest, and follow-up test for both the experimental group and the control group. \*\*\* $p < .001$ .

pretest to the posttest,  $t(31) = 5.867, p < .001$ , but decreased significantly from the posttest to the follow-up test,  $t(31) = -2.413, p < .05$ . There were no significant differences in the control group children’s prosocial lie-telling scores over time ( $ps > .148$ ). The results are illustrated in Fig. 2.

*Predicting prosocial lie-telling*

We further conducted a hierarchical regression to investigate whether the changes in AToM between the pretest and the posttest could predict children’s prosocial lie-telling in the posttest (see Table 3). The gain scores of AToM were calculated by subtracting the pretest AToM scores from

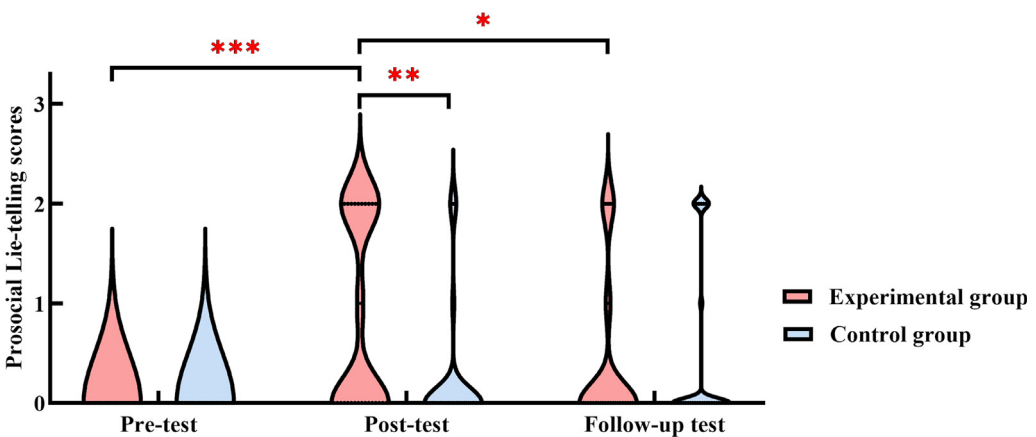


Fig. 2. Prosocial lie-telling scores of the pretest, posttest, and follow-up test for both the experimental group and the control group. \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

the posttest AToM scores. Family SES, Chinese literacy, working memory, and inhibition were entered in the regression as the first block, and the AToM gain score was entered in the second block. Results showed that the AToM gain score was the only significant predictor of children’s prosocial lie-telling in the posttest,  $F(1, 60) = 4.310, p = .042, b = .102$ , explaining 6.4% of the variance.

**Discussion**

The current study replicated the AToM training effect (Lecce & Bianco, 2018; Lecce et al., 2014) in middle childhood using a conversation-based approach. More important, children in the experimental group showed more advanced prosocial lie-telling behaviors in the disappointing gift paradigm after the 4-week AToM training. The current study is the first training study demonstrating that AToM training promoted children’s prosocial lie-telling, controlling for family SES, child’s literacy score, working memory, inhibition, and even the baseline AToM, although the training effect faded out at the 6-month follow-up test. These findings support that AToM plays a causal role in the development of school-aged prosocial lie-telling, albeit in the short term.

The finding that conversation-based training in the classroom context promoted children’s AToM performance is in line with previous reports using the same training program for improving school-aged children’s mental state understanding (Bianco et al., 2016; Gao et al., 2019; Lecce & Bianco, 2018; Lecce et al., 2014; Stewart et al., 2019). The social constructivist’s view of ToM development argues that high-quality social input focusing on mental state talk facilitates ToM development (Hughes & Devine, 2015). This study provides further evidence supporting this view. Focusing on the story characters’ mental states such as intention, belief, and emotion, the training scripts used in the current study explain how intentions cause people to act the way they do, why and how beliefs differ from person to person and change due to information access, as well as the social emotions the characters experience in the process. Children in the experimental group also had the chance to practice their mental state understanding and reasoning skills by composing their own strange stories and replacing the mental state terms in sentences with comparable ones. The rich mental state content was the key to the experimental group’s enhanced AToM performance.

The main aim of the current study was to examine how conversation-based training focusing on mental states might affect children’s prosocial lie-telling. The results demonstrated that after a short-term conversation-based training, children who initially could not tell a prosocial lie in the experimental group showed significantly greater gains in prosocial lie-telling than those in the control group at the posttest. Furthermore, the changes in AToM from the pretest to the posttest predicted children’s prosocial lie-telling in the posttest. To the best of our knowledge, this is the first study showing that mental-state conversation training improves prosocial lie-telling in middle childhood. The finding extends the earlier meta-analysis (Imuta et al., 2016), indicating that ToM is associated with children’s prosociality, and it further highlights the causal role of mental state understanding and reasoning in children’s prosocial behavior. This finding resonated with Ding et al.’s (2015) report that training ToM in early childhood caused previously honest preschoolers to lie. Notably, different

**Table 3**  
Hierarchical regression predicting prosocial lie-telling.

		<i>b</i>	<i>SE</i>	$\beta$	95% CI
Step 1	SES	−0.075	0.049	−0.195	[−0.173, 0.023]
	Chinese	0.011	0.018	0.079	[−0.025, 0.048]
	WM	−0.005	0.005	−0.126	[−0.014, 0.005]
	Inhibition	0	0.001	−0.028	[−0.002, 0.001]
Step 2	SES	−0.067	0.048	−0.173	[−0.163, 0.029]
	Chinese	0.016	0.018	0.112	[−0.02, 0.052]
	WM	−0.004	0.004	−0.1	[−0.013, 0.005]
	Inhibition	0	0.001	0.001	[−0.001, 0.001]
	AToM gain	0.102	0.049	0.259*	[0.004, 0.201]

Note. CI, confidence interval; SES, socioeconomic status; WM, working memory; AToM, advanced theory of mind.

\*  $p < .05$ .

from the findings of [Ding et al. \(2015\)](#) that primarily focused on much younger children's self-serving lies, the current study revealed the causal association between AToM and school-aged children's prosocial lie-telling, indicating that mental state understanding is a key component in children's use of sophisticated social strategies throughout childhood.

The posttest in the current study was administered 2 weeks after the training sessions were completed. The significant training effect on children's prosocial lie-telling was comparable to [Ding et al.'s \(2015\)](#) follow-up tests of younger children's self-serving lie-telling up to 6 days after the training sessions. In contrast to [Lecce et al.'s \(2014\)](#) finding that their conversation-based training had a sustained effect on AToM performance at a 2-month follow-up, the current study did not find such an enduring effect on AToM in a follow-up test with a much longer time interval of 6 months after the training. Neither was the training effect on prosocial lie-telling sustained at the 6-month follow-up. These findings are consistent with the well-documented fade-out effect of educational interventions ([Bailey et al., 2020](#)). The fade-out in the current study might be related to the control group's catch-up, as evidenced by the steady increase in the control group's prosocial lie-telling from the pretest to the follow-up test, likely due to maturation and other learning-conducive environmental exposure. Given the very brief 4-week intervention, the fade-out might also be attributed to the lack of environmental affordances after the intervention ended. For example, like the control group, the experimental group's AToM remained more or less the same from the pretest to the follow-up test despite a dramatic spike in the posttest. This might indicate a context effect where the environmental experiences of the training sessions were not sustained after the training ended. [Bailey et al. \(2020\)](#) suggested the possibility of later emergence of relevant skills after interventions. Future research is warranted to examine the long-term effect of ToM training on a wide range of children's social behaviors.

### Implications

Despite violating the moral value of honesty, prosocial lie-telling has the moral intention of benefiting others out of compassion and serves as a social lubricant in interpersonal communication ([Levine & Lipoli, 2022](#)). Children learn to tell prosocial lies with the development of executive function and mental state understanding ([Sai et al., 2021](#)). In addition, cultural norms and social input also affect the emergence of prosocial lie-telling. Our study indicated that children's exposure to conversations rich in contrasting beliefs, intentions, and emotions was conducive not only to their understanding of others' mental states ([Lecce et al., 2014](#)) but also to their enhanced interpersonal skills, in this case of telling prosocial lies. For parents and educators, engaging children in mental state talk in everyday communication could foster compassion and social-emotional competence, which lay the foundation for relationship building and well-being throughout the lifespan. Our study has demonstrated that it is feasible to do so in a classroom setting with efficiency and provided a protocol for future training programs.

### Limitations

The current study is not without caveats. First, this study did not disentangle the specific training effects of the different types of strange stories on children's prosocial lie-telling. Future research may develop targeted training programs to understand how specific types of mental state narratives, such as misunderstanding, persuasion, double bluff, white lie, and joke, are associated with children's prosocial lie-telling. Second, the current research did not consider the role of moral emotions in prosocial lie-telling. It has been argued that prosocial lies are associated with empathy and compassion ([Lupoli et al., 2017](#); [Nagar et al., 2020](#)). Future research should take morality, empathy, and compassion into consideration. Third, unlike the experimental group, the active control group did not engage in story composition or verb exercises in their story reading sessions. Future studies need to better align the training protocols between groups. Furthermore, the small sample size of the current study might limit the detection of the training effects. Preregistered replications with large samples are warranted.

## Conclusion

The findings of this study extend the existing literature on the relation between AToM and prosocial lie-telling in school-aged children by showing that AToM training could cause children to begin telling prosocial lies, albeit in the short term. Moreover, the current study provided new evidence that classroom-based AToM training may be beneficial for the development of prosocial behavior in children.

## Acknowledgments

We thank the teachers and children for participating in this study. This work was supported by the Emerging Cross-Discipline of Philosophy Social Science Foundation of Zhejiang Province (21XXJC05ZD) and the Youth Foundation of Social Science and Humanity, China Ministry of Education (20YJCZH033). The funding agency had no involvement in the study design; the collection, analysis, and interpretation of data; the writing of the manuscript; or the decision to submit the manuscript for publication.

## Data availability

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

## Appendix

### *Stories for the experimental group*

#### 1. Misunderstanding

*Story A:* Xinxin was taking out the garbage at night when he saw his neighbor's cat running away. Xinxin wanted to catch the cat and return it to his neighbor, Mrs Yu. Just as he caught the cat, Mrs Yu opened the door and saw the cat struggling in the arms of a boy. Mrs Yu was not wearing her glasses, so she could not see very well. She called out, "Quick, somebody catch that cat thief!"

*Story B:* Yang Lin was riding the bus to school. He noticed the girl standing in front of him carrying an unzipped backpack, and a pickpocket was trying to steal her purse from the inside of her backpack. Yang Lin tried to whisper to the girl to alert her. But she wore headphones with music on and could not hear him. Yang Lin tried to zip up her backpack for her instead. This was when the girl turned around and saw Yang Lin's hand on her backpack. She pulled back her backpack and called out, "Look, here is a thief!"

#### 2. Persuasion

*Story A:* Ming and Hong are best friends. They trust each other. Today Hong was on her way to the park to play on the new swing set when she ran into Ming's Mom. Ming's Mom reminded Hong to play safe in the park, then went grocery shopping. When Hong got to the park, she found Ming on the new swing set. She asked Ming if she could have a turn on the swing, Ming said, "No, I'm still playing." Hong waited for a long time, but Ming just would not come off the swing. Hong wanted to play on the swing so much. She then told Ming, "I ran into your Mom just now. She needed you to go home as soon as possible."

*Story B:* There was a beggar who was secretly very rich, but he was greedy and always wanted more money. One day he saw a rich business person on the street. He went up to the business person and said, "Please have mercy, I'm too poor to even buy myself food. Could you please give me some money?"

### 3. Double bluff

*Story A:* Zhang Jie and Wendi both like chocolate. They now reached the last piece of chocolate in the box. Both wanted to keep the last piece. While Wendi was not paying attention, Zhang Jie hid it in the cupboard. Wendi saw the chocolate was gone and asked Zhang Jie, "Where did you hide the chocolate?" Wendi knew Zhang Jie used to put chocolate in either the blue cupboard or the red cupboard, and she knew Zhang Jie would not want her to find the chocolate. Zhang Jie said, "I put it in the blue cupboard."

*Story B:* Kids in a class were playing a game of finding marbles today. The class was divided into two groups, Group A and Group B. One group would hide the marbles in either a black box or a white box, while the other group was given only one chance to find them. Now it was Group B's turn to find the marbles hidden by Group A. Group A hid the marbles in the black box. Kids in Group B knew that Group A did not want them to win the game. When Group B asked Group A where they hid the marbles, Group A kids said, "The marbles are in the white box."

### 4. Joke

*Story A:* Ding Ding has always been a little chubby, and he is self-conscious about his weight. Lala is a boisterous kid and likes to tell jokes. Ding Ding and Lala are in the same class but they have never spoken to each other before. For today's field trip to the supermarket, Ding Ding and Lala were assigned to the same group. They walked into the supermarket side by side awkwardly not knowing how to start a conversation. They stopped at a large barrel of rice. Lala said, "Ding Ding, this is the exact portion for your dinner." Ding Ding managed a smile and then lowered his head.

*Story B:* Chenchen is a very cheerful child. Today she stepped into the classroom and realized that she had the exact same outfit as Yuan, a girl she did not know very well. What a coincidence! Other kids in the classroom noticed that they dressed the same and asked them why. Chenchen looked at Yuan and said, with a grin, "That's because the two of us are twins!" Yuan, on the other hand, was puzzled. She shook her head at Chenchen.

## *Stories for the control group*

### 1. Session 1

*Story A:* It is Friday. The teachers usually assign some homework on Fridays for the kids to do during the weekend. Lily used to note down all her homework assignments in her journal. That is what she did during the English class today. After the English class, she went to the art studio for the visual art class. The art teacher asked them to hand in a family portrait on Monday. After visual art, Lily went to the gymnasium for the PE class. The last class today was computer science in the computer lab. Lily realized she did not have her journal with her when the computer science teacher started to assign homework. She told the teacher about it. The teacher went to the art studio and the gymnasium to look for Lily's journal but did not go to the English classroom.

*Story B:* Today is Saturday. Dan and Chao went to the supermarket. Dan usually brings her own environmentally friendly grocery bag with her when she goes shopping. They first went to the dry food section to get rice, then went to the fresh food section to buy tomatoes. Chao said to Dan, "I'll wait for you at the register." Dan agreed and went to get chocolate in the snack section. At the register, Dan realized that while she had the rice and the chocolate, the tomatoes she picked out earlier were nowhere to be seen. Dan gave Chao the rice and the chocolate and went back to the fresh food and the snack section to look for her tomatoes.

### 2. Session 2

*Story A:* Cong went for a walk to get some fresh air. Unfortunately, it started to rain while he was out. Luckily, Cong had an umbrella with him. He opened his umbrella. A gust of wind blew Cong's umbrella into the bushes. The bushes had pricks. Cong managed to retrieve his umbrella from the

bushes and went home with it. When he got home, however, he realized that his hair was wet although he used the umbrella.

*Story B:* Sun Bin was a military strategist during the Spring and Autumn and Warring States periods. He was a friend of General Tian Ji from the Kingdom of Qi. Tian Ji and the King of Qi both liked horse racing. They used to each choose three horses, classify them as good, better, and the best, and race against each other. The winner is the one who won at least two rounds out of three. Both of them were using their “good” horse against the opponent’s “good” one, “better” horse against the opponent’s “better” one, and “best” horse against the opponent’s “best” one. The King was always winning because he had slightly more superior horses in all three levels. Sun Bin convinced Tian Ji that he could ensure victory if Tian Ji followed his strategy. Sun Bin used Tian Ji’s “good” horse against the King’s “best” horse, then used the “best” horse against the King’s “better” one, and lastly the “better” horse against the King’s “good” one. Tian Ji lost the first round but won the other two rounds, and hence won the match. To turn defeat into victory, all it took was to follow a different sequence with the same horses.

### 3. Session 3

*Story A:* Nina bought a new lamp yesterday. Now she needed a light bulb for her new lamp. She found two brands of light bulbs in the shop, Brand A and Brand B. The unit price of Brand A is lower than that of Brand B. But Brand A is sold in packages of six, while Brand B is sold individually. Although Nina only needed one light bulb, she decided to buy a package of six light bulbs in the end.

*Story B:* Rong is planning to invite friends to come over for dinner. She is good at making home-made mayonnaise. She bought fresh eggs for making mayonnaise. She follows the recipe, which says: Carefully divide the yolk and egg white, put the yolks in a bowl and add oil gradually. Now Rong has made mayonnaise. She goes on to search for a recipe for an egg white pancake since she is not going to waste any food.

### 4. Session 4

*Story A:* It was snowing earlier today. Beibei went outdoors and made a snowman in his yard. It was a good-looking snowman! After Beibei went to bed at the end of the day, the outside temperature started to rise overnight. The snowman melted in the morning. Nothing was left at the spot where the snowman was other than a puddle of water.

*Story B:* Amanda’s room was renovated. Her Mom painted the walls and hung new curtains. Amanda’s room used to be pale pink with sheer curtains. Now the room is burgundy with brand-new thick velvet curtains. Amanda overslept the first day she stayed in the new room. When her Mom woke her up and asked her to hurry up to go to school, Amanda asked: “Why so early? Isn’t it still the middle of the night?”

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