The Influence of Second-Order Perspective-Taking on Cooperative Interaction in 3-Year-Olds

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Abstract

This study investigated second-order perspective-taking in 3-year-old children using the classic turtle task (Experiment 1) and a modified filter task (Experiment 2), and examined its changes before and after brief social interactions. The results showed that (1) 3-year-old children still found it difficult to spontaneously engage in second-order perspective-taking, but already possessed the potential to perform this processing; (2) brief cooperative interactions could, to some extent, increase children' s success rate in adopting others' perspectives, whereas competitive interactions had no similar effect. This finding provides new evidence for explaining the development of visual perspective-taking from a constructivist perspective.

Full Text

Preamble

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Answer: The innovative contributions of this study are as follows:
(1) It is generally believed that Level 2 visual perspective-taking does not emerge before age 4. Recent Western research has proposed that under specific conditions, 3-year-old children also show certain perspective-taking abilities; however, no domestic studies have since investigated 3-year-old children. The current study found that 3-year-old Chinese children also show budding signs of this ability. At this age, children' s egocentric tendency in Level 2 visual perspective-taking is no longer pronounced, but they still have difficulty fully overcoming interference from others' perspectives.
(2) Constructivist developmental theory, based on Piaget' s and Vygotsky' s theories of cognitive development, proposes that cooperative interaction plays an important role in the development of children' s perspective-taking abilities. Previous related research has focused on examining the relationship between social perspective-taking and theory of mind and other higher-level mental state reasoning, while neglecting perspective-taking that processes more basic visual-perceptual information. This study found that developing Level 2 visual perspective-taking in children can be enhanced through cooperative interaction, filling an important gap in understanding the nature of children' s visual perspective-taking and the influence of cooperative interaction on it.

2. Have you published or submitted any articles using the same data as this study? If yes, please attach them for review. (We do not encourage authors to publish multiple articles with the same variables from the same data, nor do we encourage splitting a series of related studies into multiple publications.)

Answer: No.

3. Studies in management, clinical, personality, and social domains that rely solely on self-report (questionnaire methods) need to check for common method bias. What methods did you use to control or demonstrate that such bias would not affect the validity of your conclusions? (For literature on common method bias, see: http://118.145.16.229:81/Jweb_xlkxjz/CN/abstract/abstract882.shtml) Studies based on cross-sectional data with only self-reports, measured only in convenience samples, are easy to conduct but typically have limited innovative value and low chance of acceptance.

Answer: No questionnaires were used.

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Answer: Not a clinical experiment.

5. Did you report and analyze effect sizes (e.g., Cohen' s d for t-tests, Eta-squared or partial Eta-squared for ANOVA, standardized regression coefficients)? (Many studies mechanically report effect sizes without necessary analysis or explanation, such as whether the effect size is small, medium, or large, and what theoretical or applied significance it has.) (Searching "effect size calculator" on Google yields many convenient apps. For explanations of effect sizes in Chinese, see: http://118.145.16.229:81/Jweb_xlkxjz/CN/abstract/abstract1151.shtml; in English, see: http://www.uccs.edu/lbecker/effect-size.html) Did you report 95% CI for statistical analyses? (e.g., 95% CI for differences, 95% CI for correlation/regression coefficients) For calculation and graphing of confidence intervals, see https://thenewstatistics.com/itns/esci/.

Answer: The data in this study are non-parametric. The results report and analyze and V values.

6. Please state the planned sample size and actual sample size. If they differ, please state the reason. The problem of low statistical power due to insufficient sample size has been widespread in previous psychological research. We recommend explaining in the Methods section the basis for your sample size calculation and determination. Sample size should be determined based on a justified effect size and desired power, and report the software or program used for calculation. For rationale and practices of sample size planning, see https://osf.io/5awp4/.

Answer: To facilitate comparison with previous similar studies (Jin, Li, He, & Shen, 2017, 2018; Li, Jin, He, & Shen, submitted; Moll & Tomasello, 2011), the planned sample size was set at 24 participants per group. The actual sample size was 24 participants per group. According to calculations using G-Power software, this sample size meets requirements. The above rationale for sample size determination has been reported in the Participants section of Experiment 1.

7. In hypothesis testing, if using null hypothesis significance testing (NHST), you must report exact p-values rather than p-value intervals (report intervals only when $p < 0.001$, otherwise report exact p-values). Does your paper meet this requirement? If using Bayes factors, have you reported its sensitivity to prior distribution assumptions?

Answer: This study reports exact p-values for all results, with intervals reported only when $p < .001$.

8. To ensure completeness of data reporting in the paper, if some data were excluded in statistical analysis, was this reported in the text? What was the reason? How would the statistical results change if this portion were included? How were missing data handled in statistical analysis? When using scales, were any individual items deleted? What was the reason? How would the statistical results change if these items were included? Were there any measured items or variables not reported? What was the reason? Please state the location in the paper.

Answer: A total of 6 participants were excluded from this study, with reasons reported in the Participants sections of Experiments 1 and 2. Five participants failed to complete all data collection and could not be included in statistical results; the remaining 1 participant had no impact on results.

9. Are any experimental materials, scales, or questionnaires that have not undergone peer review and examination attached at the end of the file for review? If not, please state the reason. If this article is published, are you willing to share this procedure with other researchers?

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Answer: Personal information of participants in the raw data is omitted for confidentiality reasons; all other information may be shared.

11. If your study used human or animal subjects, was it approved by your institution' s ethics committee? If yes, please send a scanned copy to the editorial office email. If no, please explain why.

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Level 2 Visual Perspective-Taking in 3-Year-Olds and the Effect of Cooperative Interaction

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Abstract

This study investigated Level 2 visual perspective-taking in 3-year-old children using the classic turtle task (Experiment 1) and a modified color-filter task (Experiment 2), and examined changes before and after brief social interaction. Results showed that: (1) 3-year-old children still had difficulty spontaneously engaging in Level 2 perspective-taking, but already possessed the potential for this processing; (2) Brief cooperative interaction could, to some extent, improve children' s success rate in taking others' perspectives, whereas competitive interaction had no similar effect. These findings provide new evidence for explaining the development of visual perspective-taking from a constructivist perspective.

Keywords: young children; Level 2 visual perspective-taking; social interaction; cooperation; constructivism

1 Introduction

Visual perspective-taking refers to an individual' s recognition and inference of others' visual-perceptual states and constitutes one of the core cognitive prerequisites for understanding and engaging in social interaction and forming diverse social morality and culture (Freundlieb, Sebanz, & Kovács, 2017; Mattan, Rotshtein, & Quinn, 2016; Zhao, Wang, & Su, 2010). It provides rich perceptual cues for individuals to understand their environment and make theory-of-mind inferences (Apperly & Butterfill, 2009; Gopnik & Astington, 1988), enabling us to transcend the limitations of our own perceptual scope and engage in more complex intellectual and social activities. Therefore, it is necessary to conduct

in-depth investigations into the developmental patterns and mechanisms of visual perspective-taking.

Regarding developmental patterns, current academic consensus holds that there are two levels of visual perspective-taking: Level 1 and Level 2 (Flavell, 1974; Flavell, Everett, Croft, & Flavell, 1981), which emerge at different ages. Level 2 perspective-taking is generally believed to develop around age 4 (Flavell et al., 1981; Masangkay et al., 1974), although some research suggests this ability may begin to emerge around age 3 (Moll & Meltzoff, 2011). The mechanisms underlying the development of visual perspective-taking remain largely unclear; among these, constructivist theories of cognitive development propose that cooperative interaction constitutes an important mechanism (Carpendale & Lewis, 2004, 2015; Moll & Tomasello, 2007). Therefore, this study investigates the developmental status of Level 2 perspective-taking at age 3 and the influence of cooperative interaction on this ability.

Children's performance in visual perspective-taking demonstrates a developmental trend from egocentrism to decentering. When taking others' perspectives, younger children typically show more pronounced egocentric tendencies—that is, "projecting oneself onto others" —making inferences about others based on their own perspective. In Piaget' s famous "Three Mountains Experiment" (Piaget & Inhelder, 1956), younger children typically mistakenly report the scene they themselves see as what the doll sees. This phenomenon occurs because the activation and processing of one' s own visual perspective is typically automatic and occupies a clear advantage (Aïte et al., 2016; Epley, Keysar, Van Boven, & Gilovich, 2004). Taking others' perspectives requires individuals to engage in intentional cognitive control to inhibit interference from their own perspective (Aïte et al., 2016; Qureshi, Apperly, & Samson, 2010). Young children' s cognitive control abilities are relatively weak; as they age, these abilities continuously improve, and this egocentric tendency gradually diminishes (Aïte et al., 2016; Frick, Möhring, & Newcombe, 2014).

Children successively develop two levels of visual perspective-taking abilities during development: Level 1 and Level 2 perspective-taking (Flavell, 1974; Flavell et al., 1981). Level 1 perspective-taking refers to inferences about whether an object is visible from a specific other person' s viewpoint. Level 2 perspective-taking refers to inferences about the specific content that others see. In the "Three Mountains Experiment," for example, what is examined is children' s Level 2 perspective-taking processing: they need to infer what the mountain model most likely looks like from the doll' s perspective. Level 1 perspective-taking can only meet limited cognitive demands; to successfully engage in various more complex social-cognitive activities, individuals must possess the ability to engage in Level 2 perspective-taking. Therefore, the development of Level 2 perspective-taking ability has always been a focus of researchers' attention.

In Piaget' s research and studies using similar paradigms (Frick et al., 2014), children did not overcome the egocentric tendency in Level 2 perspective-taking and pass the Three Mountains Experiment until around ages 8-9. However,

because the scenario in the "Three Mountains Experiment" was too complex and unfamiliar for children, it greatly underestimated children' s developmental level. Therefore, subsequent researchers often used the "turtle task" (Masangkay et al., 1974) to test children' s Level 2 perspective-taking ability. In this task, the child and experimenter sit opposite each other with a picture of a turtle placed flat between them. From the child' s perspective, the turtle' s head faces upward, while from the experimenter' s perspective, it faces downward; the child needs to report the orientation of the turtle as seen by the experimenter. Based on this type of task, researchers generally believe that children develop Level 2 perspective-taking ability around ages 4–5 (Flavell et al., 1981; Marcovitch et al., 2015; Masangkay et al., 1974).

A relatively recent study (Moll & Meltzoff, 2011) further proposed, using a modified paradigm, that Level 2 perspective-taking ability begins to emerge at age 3. This study used a "color-filter task" adapted from false-belief research designs to investigate Level 2 perspective-taking ability in 36-month-old Western children. In the task, children and the experimenter viewed the color of objects through different colored filters and identified which object the experimenter was referring to based on the experimenter' s color description. The study found that children' s selection accuracy in this task exceeded chance level, leading the researchers to infer that these children had already shown preliminary signs of Level 2 perspective-taking. This discovery pushed the age of emergence of Level 2 perspective-taking to an even younger age. However, few studies have since replicated this finding. Moreover, this conclusion was based on Western participants, leaving a gap in our understanding of whether Chinese children begin to show Level 2 perspective-taking at age 3. Cross-cultural research has found that Chinese children show an advantage over Western children in the development of visual perspective-taking, particularly in overcoming egocentric tendencies (Wu, Barr, Gann, & Keysar, 2013). Therefore, it is reasonable to infer that Level 2 perspective-taking should also begin to develop in Chinese children at age 3.

Regarding the developmental mechanisms of Level 2 perspective-taking ability, no consensus has been reached. One view that can be called constructivist posits that human cognitive development, including Level 2 perspective-taking, originates from construction through participation in social interaction (Carpendale & Lewis, 2004, 2015; Moll & Tomasello, 2007). This view can be traced back to the theories of Piaget (1995) and Vygotsky (1978), both of whom mentioned the importance of social interaction participation in individual social-cognitive development. Vygotsky believed that the fundamental mechanism of cognitive development lies in the existence of a "zone of proximal development" —a gap between what children can do independently and what they can do with assistance from more skillful others. Social interaction provides "scaffolding" that helps human intelligence bridge this gap: during interaction, interaction partners selectively transmit various information and skills relevant to understanding the current situation to children, helping them experience superior cognitive processing strategies and exhibit higher cognitive abilities. Through accumulat-

ing such successful experiences, children gradually learn to autonomously apply more advanced cognitive strategies. On this basis, subsequent researchers further inferred that different types of social interaction have different "scaffolding" effects, thereby influencing the direction of children's cognitive construction during interaction (Carpendale & Lewis, 2004).

Much evidence indirectly suggests that cooperative interaction likely has a positive influence on the emergence and development of children' s Level 2 perspective-taking ability. First, for adults, recent studies have found that participating in highly cooperative social interaction can increase adults' tendency to take others' perspectives in Level 2 perspective-taking tasks and the degree to which individuals computationally represent others' perspectives (Simpson & Todd, 2017; Surtees, Apperly, & Samson, 2016). Second, children's performance in social perspective-taking and theory-of-mind tasks similar in nature to Level 2 perspective-taking can be improved through cooperative interaction: research has generally found that participating in cooperative games or teaching activities can improve children' s performance when processing or treating others' mental states that differ from their own, including cognition (Lin, Cheng, Li, & Wu, 2003; Zhang & Lin, 1999), emotion (Barragan & Dweck, 2014; Lanzetta & Englis, 1989; Lin et al., 2003; Zhang & Lin, 1999), belief (Lewis, Freeman, Kyriakidou, Maridaki-Kassotaki, & Berridge, 1996), and desire (Jin, Li, He, & Shen, 2017, 2018). These tasks are similar in nature to Level 2 perspective-taking in that they all involve interpreting the specific content of others' mental states. However, compared with these tasks, Level 2 perspective-taking processes more basic perceptual information, making it difficult to directly apply these conclusions to explain the development of Level 2 perspective-taking. Third, some signs of cooperative effects have also been found in children' s visual perspective-taking. For example, the aforementioned cross-cultural differences (Wu et al., 2013) led researchers to speculate that this may be related to the fact that collectivist cultural tendencies involve more cooperative interactions, guiding individuals to allocate more attention to others. Additionally, in applied fields, there have been proposals to use cooperative games to intervene in autistic children with impaired visual perspective-taking development (Liu, 2014). All this evidence indirectly reflects that participation in cooperative interaction may contribute to the development of children' s Level 2 perspective-taking ability.

A recent study found that 4-year-old children' s performance in a "perspective-confronting" task related to Level 2 perspective-taking could be enhanced by short-term cooperative interaction (Li et al., 2019), providing important clues about the causal relationship between cooperation and children' s Level 2 perspective-taking ability. Perspective-confronting refers to the understanding of differences between different individuals' perspectives. In the experiment, children and others viewed the color of the same object through different colored filters, and the researchers examined whether they could flexibly and accurately report both parties' different perceptual states. The study found that 4-year-old children' s performance in this task was related to the type of social interaction they had previously participated in: children who had previously

participated in cooperative interaction could simultaneously report their own and others' perceptions of the object' s color, whereas children who participated in non-cooperative interaction or no interaction still showed obvious egocentric tendencies and mistakenly reported the content of others' perspectives as what they themselves saw. However, this study cannot directly prove that cooperative interaction improves children' s Level 2 perspective-taking level: perspective-confronting requires not only that participants take others' Level 2 visual perspectives but also that they flexibly switch between their own and others' perspectives. This additional processing demand makes it difficult to determine from these results whether Level 2 perspective-taking itself was improved through cooperative interaction. Moreover, according to Vygotsky' s "zone of proximal development" theory, if cooperation has a constructive effect on the development of Level 2 perspective-taking, this effect should be mainly manifested in its budding stage—age 3. Therefore, it is necessary to further investigate 3-year-old children.

Based on the above analysis, this study aims to experimentally investigate Level 2 perspective-taking development in 3-year-old children and the impact of cooperative interaction. The experiment employs two different Level 2 perspective-taking tasks: Experiment 1 uses the classic "turtle task,"while Experiment 2 uses the "color-filter task"modified by Moll et al. (2011). In terms of social interaction task settings, to determine whether the impact of cooperative interaction is specific to cooperation or is universally produced by social interaction participation, it is necessary to set up a non-cooperative interaction group as a control. Based on this consideration, the current experiment adopts the fishing game paradigm from Jin et al. (2017) as the social interaction task, with a cooperative task for the cooperation group and a competitive task for the control group. Participants first receive a Level 2 perspective-taking pre-test to assess their developmental level, then engage in a 3-minute cooperative or competitive interaction game with an adult experimenter, followed by a Level 2 perspective-taking post-test to observe differences in participants' perspective-taking performance between the two tasks. This study' s hypotheses are as follows: (1) 3-year-old children may already show budding signs of Level 2 perspective-taking; (2) Participation in cooperative interaction can improve 3-year-old children' s Level 2 perspective-taking performance, enabling them to respond more stably according to others' rather than their own perspectives, whereas competitive interaction will have no significant effect.

This experiment used the classic "turtle task" to investigate how children' s perspective-taking is affected by cooperative interaction. The "turtle task" is one of the most widely used paradigms in the field of children's visual perspective-taking research. Previous studies have generally found that children pass this task between ages 4–5. This experiment aims to explore whether 3-year-old children can improve their likelihood of passing this task with the assistance of cooperative interaction.

2.1.1 Participants

Forty-eight children from a nursery class in a kindergarten in Jinhua City, Zhejiang Province were randomly selected to participate in this study. Participants were randomly assigned to either a cooperation group (13 boys, 11 girls, mean age = 35.86 months, range = 30.00–40.33 months) or a competition group (11 boys, 13 girls, mean age = 35.96 months, range = 30.00–39.60 months), with 24 participants in each group. This sample size was determined based on previous similar studies and calculated using G-Power software to meet research requirements. One additional child participated in the study but was excluded due to reporting negative emotions after the game.

2.1.2 Experimental Design

This experiment used a 2 (interaction type: cooperation, competition) × 2 (perspective-taking measurement: pre-test, post-test) mixed design. Interaction type was a between-subjects variable, and perspective-taking measurement was a within-subjects variable. Each participant first received a Level 2 perspective-taking "turtle task" pre-test, then completed a 3-minute cooperative or competitive social interaction game with an adult experimenter, and finally received a "turtle task" post-test.

(1) Social Interaction Game: Experimental materials included 20 plastic "fish," two plastic baskets, and two sets of fishing rods. As shown in Figure 1 [Figure 1: see original paper], the fishing rods in the cooperation game were two rods connected at the top with a hook suspended in the middle, while the fishing rods in the competition game were two independent rods, each with a hook attached at the top.

Figure 1. Social Interaction Game "Fishing Game"

The game rules required participants to use fishing rods to hook fish scattered on the table and transfer them to baskets. The game lasted 3 minutes. Participants in the cooperation group were told their goal was "to fish together, and the more fish you catch in 3 minutes, the better," while participants in the competition group were told their goal was "to compete with the teacher (Experimenter 2) in fishing, and whoever catches more fish in 3 minutes wins." In terms of operation rules, participants in the cooperation group needed to operate the connected fishing rods together with their partner to catch fish into a shared basket, while participants in the competition group operated their own rods independently to catch fish into their own baskets.

After the perspective-taking pre-test, Experimenter 1 introduced the fishing game rules to the participant and Experimenter 2, demonstrated how to operate the fishing rods (competition group) or demonstrated how to operate the connected rods in coordination with Experimenter 2 (cooperation group), and asked the participant and Experimenter 2 to practice fishing operations as demonstrated. The practice ended when the participant successfully com-

pleted at least one fishing attempt according to the game rules. After practice, Experimenter 1 announced the official start of the game. During the game, Experimenter 2 served as the participant' s teammate (cooperation group) or opponent (competition group), while Experimenter 1 was responsible for timing and providing commentary on the game process to strengthen the cooperative or competitive atmosphere. In the cooperation game, commentary included three types: "You guys are doing great," "You guys caught one," and "Are you going to catch the next fish?" Additionally, Experimenter 2 communicated the cooperative goal with the participant multiple times during fishing, including two forms: "Let' s catch this fish" and "Which one should we catch?" During this process, the experimenters used plural personal pronouns ("you guys," "we"). In the competition group, Experimenter 1' s commentary included three types: "You' re doing great!" "You caught one," and "Who will catch the next fish?" To control for the irrelevant variable of how much Experimenter 2 spoke, Experimenter 2 frequently stated their goals in a self-talking manner during the competition game, including two forms: "I' m going to catch this fish" and "Which fish should I catch?" The experimenters used singular personal pronouns ("you," "I," "who"). During the game, if the participant occasionally became distracted or did not follow game rules, Experimenter 2 (cooperation group) or Experimenter 1 (competition group) gave the instruction "Keep fishing!" If after multiple corrections the participant still did not follow the rules, or if the participant had obvious difficulty with or resistance to the game operation, that participant was excluded. At the end of the game, Experimenter 1 asked the participant to count the fish caught by both parties as feedback on whether the game goal was achieved. During the game, each valid participant successfully caught at least 3 fish according to the rules, indicating that these participants had basic participation ability in the interaction.

To control for the possible influence of negative emotions on participants' post-test performance, this experiment implemented the following operations to control negative emotions. First, Experimenter 2 regulated their own performance to ensure the participant won by a narrow margin, and the experimenters praised the participant' s victory at the end to minimize or eliminate negative emotions as much as possible. Second, after the fishing game, Experimenter 1 used the Self-Assessment Manikin (Lang, Bradley, & Cuthbert, 1997) to conduct a simple emotion assessment to further exclude the influence of negative emotions. This scale is non-verbal and has been widely used for child emotion assessment in similar studies. Based on experience, although 3-year-old children can report emotion types when using the complete scale, they have difficulty reporting emotion intensity. To reduce the cognitive load imposed by emotion assessment, only the more positive, neutral, and more negative expression stimuli from the pleasure dimension were used to simply assess the participant' s emotion type. During assessment, participants first identified each expression to ensure they understood the emotion type, then selected the one that best matched their current mood from the three expressions. Participants who selected negative emotions were excluded.

(2) Level 2 Perspective-Taking Task: The task was adapted from the "turtle task" used by Flavell et al. (1981). The pre-test and post-test procedures were identical, only the material patterns differed. At the beginning of each task, Experimenter 2 sat opposite the participant (as shown in Figure 2 [Figure 2: see original paper]). Experimenter 1 took out an A4-sized picture of a turtle or rabbit viewed from above (different patterns for pre-test and post-test, with order counterbalanced across participants). Experimenter 1 first placed the picture upright in front of the participant so the turtle/rabbit was in an upright or inverted position (different orientations for pre-test and post-test, with order counterbalanced), then named the orientation in each state: "Look! Now this little turtle/rabbit is standing on its feet/standing on its head." After confirming that the participant accepted the naming of both orientations, Experimenter 1 placed the picture flat on the table with the head and tail of the pattern facing the participant and Experimenter 2 respectively (orientation counterbalanced across participants), then asked about the participant' s understanding of Experimenter 2' s perspective: "Now looking from this teacher' s side, is this turtle/rabbit standing on its feet or standing on its head?" A valid response was defined as the participant giving a verbal report containing clear orientation information or immediately clearly indicating agreement after the experimenter spoke the corresponding instruction. If the participant did not give a valid response, the complete orientation naming procedure was repeated once, then the picture was placed back and the participant was asked, "Now looking from this teacher' s side, is this turtle/rabbit standing on its feet? Is it standing on its head?" Valid responses included giving a verbal report containing clear orientation information or making different yes/no responses to the two questions verbally or non-verbally. If the participant still could not give a clear valid response at this point, it was considered an invalid response. Experimenter 2 recorded the participant' s response and scored it based on whether it matched Experimenter 2' s perspective content. Valid responses matching Experimenter 2' s perspective were scored 1 point; valid responses not matching or invalid responses were scored 0 points.

Figure 2. Schematic Diagram of Experiment 1 "Turtle Task" Scenario

2.2 Results and Analysis

Table 1 Participant Scores in Experiment 1 "Turtle Task"

Group	Pre-test Score 0	Pre-test Score 1	Post-test Score 0	Post-test Score 1
Cooperation	21 (87.50%)	3 (12.50%)	16 (66.67%)	8 (33.33%)
Competition	21 (87.50%)	3 (12.50%)	21 (87.50%)	3 (12.50%)

Analysis of participants' performance in each group showed the results presented in Table 1. In the pre-test task, both the cooperation and competition

groups showed a significant tendency to make incorrect or invalid responses (both groups had a correct response rate of 12.50%, $^2 = 13.50$, df = 1, ps < 0.001; the difference between groups was not significant, $^2 = 0.00$, df = 1, p = 1.000), indicating that at age 3, children have obvious difficulty taking others' Level 2 visual perspectives in the "turtle task." In the post-test, both groups still showed obvious difficulty with this task: the cooperation group' s performance was at chance level (correct response rate = 33.33%, $^2 = 2.67$, df = 1, p = 0.102). Although there was a slight upward trend in the correct response rate, it did not reach significance compared with the pre-test (McNemar test for paired samples, difference from pre-test not significant, p = 0.063). The competition group' s correct response rate remained the same as the pre-test, still showing a significant tendency to make incorrect or invalid responses (correct response rate = 12.50%, $^2 = 13.50$, df = 1, p < 0.001; McNemar test difference from pre-test not significant, p = 1.000). The difference between groups in the post-test was not significant, $^2 = 2.02$, df = 1, p = 0.286.

The most straightforward interpretation of this result is that 3-year-old children have obvious difficulty performing the "turtle task." This is relatively consistent with previous results: in Masangkay et al. (1974) and Flavell et al. (1981), children around age 3 generally failed this test. Moll et al. (2013) argued that the "turtle task" is too difficult for measuring the development of children' s Level 2 perspective-taking because the task likely involves additional cognitive demands: in the task, children' s own perspective is in an obvious advantage position, easily interfering with the process of processing others' perspectives and thereby masking children' s true ability to take others' perspectives. Additionally, the task requires children to understand or memorize the naming of pattern orientations, which may also place high demands on their language or memory abilities. Regarding the effect of cooperative interaction that we are more concerned about, no significant effects were found in the current data. Considering that the weak trend presented in the results is consistent with our expected effect—that is, only the cooperation group showed an increasing trend in the proportion of correctly taking others' Level 2 visual perspectives after interaction—we speculate that cooperation likely did produce the expected effect we anticipated, but this effect was masked by the additional demands of the task, producing an obvious floor effect. Therefore, in Experiment 2, we will use the "color-filter task" to measure children' s Level 2 perspective-taking ability again.

3.1.1 Participants

A total of 48 valid participants were randomly selected from a nursery class in a kindergarten in Jinhua City, Zhejiang Province. Participants were randomly assigned to a cooperation group (10 boys, 14 girls, mean age = 35.61 months, range = 30.97–38.73 months) or a competition group (11 boys, 13 girls, mean age = 35.21 months, range = 29.93–39.23 months), with 24 participants in each group. Four additional children participated in the study but were excluded for

the following reasons: three failed to complete testing due to noncompliance or distraction, and one reported negative emotions after interaction.

3.1.2 Experimental Design

This experiment used the same design as Experiment 1. The social interaction game settings were identical to Experiment 1. The Level 2 perspective-taking task used the "color-filter task" adapted from Moll and Meltzoff' s (2011) "color mix task."

Experimental materials included four color comparison cards (commercially available colored plastic snowflakes in blue, green, yellow, and red), two color filters (made of transparent acrylic plates, dimensions: 150mm × 200mm × 2mm, colors: transparent yellow, colorless), and two pairs of blue plastic toys (seal, approximately 5.5cm × 5.5cm × 4cm; ball, diameter approximately 5cm. Under the experimental lighting conditions, their color matched the blue comparison card; when viewed through the yellow filter, their color matched the green comparison card).

Before the perspective-taking pre-test, participants first completed a color identification test with Experimenter 1 to ensure they could identify all colors involved in the experiment, and a familiarization trial to familiarize them with the relationship between object colors and color filters. The color identification test used the comparison cards: Experimenter 1 presented four comparison cards of different colors to the participant, then asked four questions, each time stating a color name and asking the participant to select the corresponding comparison card. If the participant selected incorrectly, the experimenter repeated the color name and asked for another selection. Although all children in this study passed this test, if a participant made three errors in this test, they would be excluded.

Participants who passed the color identification test then received familiarization trials. As shown in Figure 3 [Figure 3: see original paper], Experimenter 1 presented two color filters side by side in front of the participant (position counterbalanced across the two tasks within participants), then took out a blue toy (seal or ball, counterbalanced across participants) and introduced it as "This is a little seal/ball." After confirming the participant was familiar with the toy name, Experimenter 1 placed it behind the colorless filter and invited the participant to sit in the opposite seat (the experimenter' s side). At this point, the participant saw the toy behind the colorless filter from the experimenter' s side. Experimenter 1 then slowly moved it behind the yellow filter, reminding the participant, "Look, now it' s like this color" while pointing to the green comparison card. Then it was slowly moved back behind the colorless filter at the same rate, with the reminder, "Look, now it' s like this color" while indicating the blue comparison card. The above moving and reminding steps were repeated twice each. Finally, the toy was slowly moved from the colorless side to the yellow side and back, with the reminder, "Look!" After the familiarization trial, the participant returned to the original seat (participant' s side) to begin

the perspective-taking pre-test.

Figure 3. Schematic Diagram of Experiment 2 "Color-Filter Task" Scenario

In the pre-test, Experimenter 1 first placed a pair of identical toys (seal or ball, same as in familiarization trial) on the participant' s side of the two color filters. Experimenter 2 then manipulated a monkey or rabbit hand puppet to enter the experimental scene from the experimenter' s side. Both Experimenter 2 and the puppet were positioned on the vertical extension line of the boundary point between the two filters. Experimenter 1 introduced the puppet character to the child: "Look, a little monkey/rabbit has come," while Experimenter 2 operated the puppet to attract the child's attention to the character. Experimenter 2 then operated the puppet to look at the boundary position between the two color filters and, in the character' s voice (with distinct intonation for the two characters to differentiate them), requested a toy of a certain color from the child: "I see two little seals/balls, I want the blue/green little seal/ball, can you give me the blue/green little seal/ball?" When mentioning the color, Experimenter 2 placed the corresponding color comparison card in the puppet' s hand and held it up to show the participant, further reducing the child' s language comprehension load. Experimenter 1 observed and recorded the child' s response. Valid responses included picking up a toy and handing it to the character, or clearly indicating the selection of a certain toy for the character through verbal or physical means. If the participant did not make a valid response, Experimenter 2 repeated the toy request line in the character' s voice. If the participant still did not make a valid response after three repetitions, they were excluded. The participant was scored 1 point if the selected toy matched the other' s perspective, and 0 points otherwise.

After the first request, Experimenter 2 covered the puppet' s eyes and turned away with the puppet. After Experimenter 1 ensured the participant noticed the posture change of Experimenter 2 and the character, the toys were replaced with another pair (ball or seal). After placement, Experimenter 2 operated the puppet to observe the scene from the experimenter' s side again and requested a toy of the other color in the same manner as described above. Scoring, valid responses, and exclusion criteria were the same as above. In this test, the participant' s total score was the sum of scores from the two trials in which the experimenter requested blue and green items, with a maximum of 2 points and a minimum of 0 points.

The post-test task setup was basically the same as the pre-test. To avoid children being influenced by the character' s toy selection in the pre-test, different puppet characters were used in the pre-test and post-test (monkey, rabbit, with order counterbalanced across participants). Additionally, the order of color requests in the pre-test and post-test was counterbalanced within participants.

3.2 Results and Analysis

Table 2 Participant Scores in Experiment 2 "Color-Filter Task"

Group	Pre-test Score 0	Pre-test Score 1	Pre-test Score 2	Post-test Score 0	Post-test Score 1	Post-test Score 2
Cooperation	7 (29.17%)	13 (54.17%)	4 (16.67%)	3 (12.50%)	9 (37.50%)	12 (50.00%)
Competition	8 (33.33%)	13 (54.17%)	3 (12.50%)	7 (29.17%)	13 (54.17%)	4 (16.67%)

Table 2 shows the scores of the two groups in the pre-test and post-test. McNemar tests were conducted on the two groups' performance in the pre-test and post-test separately: in the pre-test, both groups' proportion of choices based on others' perspectives was at chance level (cooperation group: $p = 0.549$; competition group: $p = 0.227$); in the post-test, the competition group' s choices remained at chance level ($p = 0.549$), while the cooperation group showed a significant tendency to choose options consistent with the other' s perspective ($p < 0.001$). The total scores obtained by children in the pre-test and post-test were compared between the cooperation and competition groups: the difference between groups was not significant in the pre-test, $^2 = 0.21$, $df = 2$, $p = 0.907$; the difference was significant in the post-test, $^2 = 7.64$, $df = 2$, $p = 0.022$, $V = 0.40$, with a medium effect size. Further Wilcoxon analysis of changes in total scores for the same participant between pre-test and post-test showed that the cooperation group' s post-test scores improved significantly compared with pre-test scores (pre-test mean rank = 6.50, post-test mean rank = 7.04, $z = 3.00$, $p = 0.003$), whereas the competition group showed no significant difference between pre-test and post-test scores (pre-test mean rank = 6.50, post-test mean rank = 6.50, $z = -0.58$, $p = 0.564$).

Considering that requesting green versus blue items involves different differences between perspectives and may involve difficulty differences, it is necessary to further analyze the correct response rates for the two color trials separately. In the cooperation group, judgments of both green and blue items were at chance level in the pre-test (green trial correct rate = 45.83%, $^2 = 0.17$, $df = 1$, $p = 0.683$; blue trial correct rate = 66.67%, $^2 = 2.67$, $df = 1$, $p = 0.102$), while in the post-test both significantly exceeded chance level (green trial = 83.33%, $^2 = 10.67$, $df = 1$, $p = 0.001$; blue trial = 79.17%, $^2 = 8.17$, $df = 1$, $p = 0.004$). The difference between pre-test and post-test was significant for the green trial (McNemar test for paired samples, $p = 0.004$) but not for the blue trial (McNemar $p = 0.508$). The competition group' s judgment level was at chance in both pre-test and post-test (pre-test: green trial = 58.33%, $^2 = 0.67$, $df = 1$, $p = 0.414$; blue trial = 62.50%, $^2 = 1.50$, $df = 1$, $p = 0.221$; post-test: green trial = 58.33%, $^2 = 0.67$, $df = 1$, $p = 0.414$; blue trial = 54.17%, $^2 = 0.17$, $df = 1$, $p = 0.683$). The correct response rates for both color judgments

did not change significantly between pre-test and post-test (green trial: p = 1.000; blue trial: p = 0.727). No significant differences were found between green and blue trial correct rates within each group in each test (McNemar test for paired samples: cooperation group pre-test: p = 0.267; post-test: p = 1.000; competition group pre-test and post-test: p = 1.000). Based on this, we can conclude that the difficulty of the two color trials was basically equivalent, and the effect of interaction type showed no obvious difference between the two color trials, so they will not be discussed separately.

To exclude possible influences of emotional state, we further analyzed the types of emotions reported by participants after the two games: a total of 49 participants completed the emotion assessment in Experiment 2, including 25 who participated in cooperative interaction (22 reported positive emotions, 1 reported neutral emotion, and 2 reported negative emotions) and 24 who participated in competitive interaction (22 reported positive emotions, 1 reported neutral emotion, and 1 reported negative emotion). The difference in emotion assessment between the two interaction types was not significant (^{2} = 1.34, df = 1, p = 0.513, = 0.09). This result is consistent with previous similar studies (Jin et al., 2017, 2018). Therefore, we can conclude that the effects found in this experiment are difficult to explain by emotion differences triggered by interaction types.

In summary, after short-term cooperative interaction, children' s performance in making choices based on others' perspectives improved significantly compared with before interaction; correspondingly, the same duration of competitive interaction had no obvious effect on children' s performance in this task, and participants' performance remained at chance level after interaction. Regarding the other question of concern in this study—the developmental level of perspective-taking in Chinese children at age 3—in the pre-test of this experiment, 3-year-old children still did not fully overcome egocentric tendencies, which is inconsistent with results from similar Western studies (Moll & Meltzoff, 2011). However, it should be noted that in this experiment, the perspective agent—the puppet—was operated by an experimenter, causing two sources of others' perspectives to exist simultaneously in the child' s visual field, requiring additional judgment of the perspective agent. Although previous similar studies (e.g., Jin et al., 2017, Experiment 3) have shown that the effect of cooperative interaction on children' s perspective-taking is not limited to the cooperation partner itself, and we controlled the positions of the experimenter and puppet to ensure their perspectives were consistent, we cannot rule out the possibility that this operation may have increased children's cognitive load to some extent. Therefore, we cannot directly conclude that Chinese 3-year-old children are weaker than Western children in Level 2 perspective-taking development. To exclude this possibility, we further replicated the color-filter task used by Moll et al. in Experiment 2b to directly compare the developmental level of Level 2 perspective-taking between Eastern and Western children at age 3.

4.1.1 Participants

This experiment included 24 valid participants (13 boys, 11 girls, mean age = 36.63 months, range = 31.23–40.70 months) randomly selected from a nursery class in a kindergarten in Jinhua City, Zhejiang Province. None of the participants had participated in Experiment 2 or experiments using similar tasks.

4.1.2 Experimental Design

This experiment adopted Moll and Meltzoff' s (2011) "color mix" task. The task setup was basically the same as the pre-test of the color-filter task in Experiment 2. Children successively received a color identification test, familiarization trial, and two formal test trials. In the formal test, no puppet was used; instead, Experimenter 2 served as the perspective agent. Experimenter 1 uniformly adjusted the address for this role to "teacher" in the instructions, and Experimenter 2 made requests in their own voice. At the beginning of the formal trial, Experimenter 2 entered the scene from the experimenter' s side from outside the experimental scenario. After the first request, Experimenter 2 pretended to look for something, turned around and left the experimental scenario; after replacement was completed, Experimenter 2 entered the scene again from the experimenter' s side. Other settings were the same as in Experiment 2. The toy colors requested by Experimenter 2 in the two trials were different, with order counterbalanced across participants.

4.2 Results and Analysis

Table 3 Comparison of Level 2 Perspective-Taking Scores Between Experiment 2b and Moll & Meltzoff (2011)

Data Source	Score 0	Score 1	Score 2
Moll & Meltzoff (2011) (N = 24)	1 (4.17%)	8 (33.33%)	15 (62.50%)
Experiment 2b	11 (45.83%)	5 (20.83%)	8 (33.33%)
Under 36 months group (n = 11)	5 (45.45%)	2 (18.18%)	4 (36.36%)
36 months and above group (n = 13)	6 (46.15%)	3 (23.08%)	4 (30.77%)

Table 3 shows the performance of Chinese 3-year-old children in the Level 2 perspective-taking task in Experiment 2b and its comparison with the performance of Western 3-year-old children in the same task in Moll et al.' s (2011) study. McNemar test on participants' scores in the current experiment found that the proportion of choices based on others' perspectives in the two trials was at chance level (p = 0.648). Comparison with Moll et al.' s study showed a significant difference, ^{2} = 6.75, df = 2, p = 0.034, V = 0.38, with a medium

effect size. Considering that the age distribution range of participants in Moll et al.' s study (35.72–36.59 months) differs somewhat from this experiment, the current results might be due to younger participants pulling down the overall performance. To explore this possibility, we further separated the data for participants under and over 36 months in the current experiment (see Table 3; gender distribution: under 36 months group: 6 boys, 5 girls; 36 months and above group: 7 boys, 6 girls). The results did not support this hypothesis (^{2} = 0.13, df = 2, p = 0.939, V = 0.07). Based on the above analysis and the results from Experiment 2, we believe that Chinese 3-year-old children in this experiment indeed have not yet fully demonstrated Level 2 perspective-taking ability like Western children.

5 Discussion

As an important social-cognitive ability, the developmental patterns and mechanisms of visual perspective-taking have important theoretical value. This study investigated Level 2 perspective-taking in 3-year-old children and its influence by social interaction. Children successively received a Level 2 perspective-taking pre-test, cooperative or competitive game, and Level 2 perspective-taking post-test, with perspective-taking measured using the "turtle task" (Experiment 1) and "color-filter task" (Experiment 2). The study found that although Chinese 3-year-old children still cannot stably take others' Level 2 visual perspectives, they already possess the corresponding potential; when task difficulty is moderate, cooperative interaction can effectively improve their Level 2 perspective-taking level, whereas competitive interaction has no obvious effect.

One contribution of this study is providing further understanding of the developmental level of Level 2 perspective-taking in Chinese 3-year-old children. Studies based on the classic "turtle task," including Experiment 1 of this study, have generally found that 3-year-old children show obvious egocentric tendencies (e.g., Flavell et al., 1981; Masangkay et al., 1974, etc.). Therefore, it is generally believed that 3-year-old children do not yet possess Level 2 perspective-taking ability. However, more recent research (Moll & Meltzoff, 2011) pointed out that the "turtle task" may underestimate children' s developmental level. Using the modified "color-filter task," 3-year-old Western children have shown the ability to take Level 2 visual perspectives. Experiments 2 and 2b of this study tested Chinese children using the color-filter task and found that Chinese children at age 3 still cannot spontaneously take others' visual perspectives in this task like their Western peers. This finding aligns with conclusions from related research on theory of mind that also involves processing others' perspectives (see Hou, Gong, Yan, Su, & Zuo, 2018), namely that the age at which Chinese children' s perspective-taking ability emerges is slightly later than that of Western children. However, in Experiment 2, children successfully passed the same task after cooperative interaction, further indicating that although Chinese children at age 3 have not yet explicitly demonstrated Level 2 perspective-taking ability, they already possess the corresponding potential.

A second contribution of this study is providing empirical support for the constructivist hypothesis of Level 2 perspective-taking development. According to constructivist inference, cooperative interaction should help children who are about to but have not yet developed stable visual perspective-processing abilities to improve their perspective-taking level. Previous research (Li et al., 2019) found that 4-year-old children' s performance in relatively complex perspective-taking tasks could be improved through short-term cooperative interaction participation, a finding consistent with constructivist inference. However, the task used in that study examined Level 2 perspective-taking ability while also placing high demands on executive function, and Level 2 perspective-taking is already relatively well developed by age 4 (Flavell et al., 1981; Masangkay et al., 1974). Therefore, the improvement shown by children in that task may be difficult to explain by increased Level 2 perspective-taking ability. This study tested 3-year-old children whose Level 2 perspective-taking development was not yet complete and found that cooperative interaction still showed some enhancement effect, and when task difficulty was moderate, this effect was particularly obvious. Therefore, compared with previous research, this study more directly proves that cooperative interaction has a positive influence on children' s Level 2 perspective-taking. This finding provides important insights for deeply interpreting the associations found in previous similar studies between factors such as culture, education methods, and individual differences and perspective-taking development. Hou et al. (2018) attributed Chinese children' s delayed developmental age in theory of mind to early interaction experience types: for example, compared with Western children, a higher proportion of Chinese children live in authoritarian parenting environments, and in this parenting mode, children usually do not get sufficient opportunities for cooperative interaction with adults. Therefore, subsequent research could further interpret the hindrance of authoritarian parenting to theory of mind and other perspective-taking processing abilities from the angle of lacking cooperative interaction.

Regarding the specific enhancement effect of cooperative interaction found in this study, a common alternative explanation is that the different effects of cooperative and competitive interaction stem from them eliciting different emotions. Research has found that individuals' emotional states do have a non-negligible impact on perspective-taking (Bukowski, Hietanen, & Samson, 2016; Converse, Lin, Keysar, & Epley, 2008; Todd & Simpson, 2016). However, the social interaction task used in this experiment did not elicit different emotions in children in previous similar studies (Jin et al., 2017; Li et al., 2019). No obvious effect of social interaction type on emotion was found in emotion assessments conducted immediately after social interaction. Therefore, it is reasonable to believe that emotion cannot fully explain the current effects.

Another similar alternative explanation suggests that cooperation and competition affect children's prosocial levels, and children who participate in competitive interaction are less willing to comply with others' instructions to make selections than those who participate in cooperative interaction. This speculation also has its theoretical basis: research shows that from infancy, individuals have

a tendency to punish others who are dissimilar to themselves (Hamlin, Mahajan, Liberman, & Wynn, 2013), and competition involves lower similarity of positions between individuals than cooperation. In this study, although what children took was not the perspective of the interaction partner (Experimenter 2), the puppet character was played by Experimenter 2. According to this inference, children in the competition group might be less willing to follow the character' s instructions to make selections. Although this issue was not directly controlled in this study, previous similar research (Jin et al., 2017) explored the impact of competitive interaction tasks on 4-year-old children' s intention to satisfy others' desires and found that after competitive interaction, children still had a high level of intention to satisfy others' desires, and their performance was mainly limited by their ability to take others' perspectives. Moreover, in this study, competitive interaction did not significantly reduce the proportion of children choosing options consistent with others' perspectives in the post-test, which to some extent reflects that children' s willingness to comply with others' instructions did not decrease due to competitive interaction. Therefore, this speculation also lacks sufficient persuasiveness.

In summary, we can conclude that cooperative interaction is the main reason for improving children' s Level 2 perspective-taking level in this study. It should be noted that cooperation only influenced children' s Level 2 perspective-taking within a limited range. In the post-test of Experiment 2, a considerable proportion (9/24) of children in the cooperation group still could not accurately take others' Level 2 visual perspectives in both trials, indicating that the influence of cooperation is limited. A reasonable speculation about this is that the degree of influence of cooperative interaction should be related to individuals' current developmental level: the "zone of proximal development" theory (Vygotsky, 1978) points out that scaffolding works best when it matches the current developmental level. For the children in this study, different individuals had different developmental levels, so they may have been differently affected by cooperative interaction. Subsequent research could further explore the association between the timing of interaction participation and Level 2 perspective-taking development.

Correspondingly, the competition group in this study was not significantly affected by the interaction phase. Few previous studies have examined the relationship between competitive situations and visual perspective-taking; some studies on theory of mind have explored the impact of competition, with most finding no obvious effect (e.g., Jin et al., 2017; Johnson, 1975), but applied research in educational practice has found that competitive chess tasks improved individuals' performance in theory of mind (Sigirtmac, 2016). This study fills this gap regarding visual perspective-taking and finds that competition did not have a significant impact on children' s Level 2 visual perspective-taking, which is basically consistent with mainstream findings in the theory of mind domain. This indicates that not all types of social interaction can improve children' s perspective-taking abilities, thereby further proving the uniqueness of the cooperative interaction effect.

The results of this study provide important evidence for understanding the impact of social interaction on children' s Level 2 perspective-taking. Some important questions remain unanswered in this study: First, whether cooperative interaction can have long-term effects on the development of children' s Level 2 perspective-taking. The current study only examined the short-term effects of cooperative interaction, and the relationship between this effect and long-term development remains unexplored. According to the constructivist view, children gain experience with others' perspectives through cooperative interaction, and the accumulation of experience leads to improved perspective-taking ability (Carpendale & Lewis, 2004, 2015; Moll & Tomasello, 2007). Based on this hypothesis, we expect that cooperative training for children should help their perspective-taking development. In fact, in social perspective-taking, which is highly related to visual perspective-taking, cooperative interaction training has been found to have obvious positive effects (Lin et al., 2003; Zhang & Lin, 1999), but no relevant training research has targeted visual perspective-taking. Subsequent research could consider cooperative training studies specifically targeting visual perspective-taking.

Second, how cooperative interaction improves children' s not-yet-formed Level 2 perspective-taking. We speculate that the following structural characteristics of cooperative interaction may be related to this: First, cooperative goals are represented in a unique joint mode. It requires individuals to incorporate others into representations related to behavioral goals, thereby acting in the form of "we" rather than "I." This means individuals need to pay attention to what perceptual states others possess. Warneken et al. (2006) found that around age 2, children in cooperation show an obvious tendency to pay attention to others' behavioral states. When others show intention to exit the cooperative interaction before achieving the cooperative goal, children attempt to re-guide them to resume the cooperative state.

Second, compared with other types of activities, cooperative interaction often requires a high level of behavioral coordination between individuals, making behaviors mutually constrained (Michael, Sebanz, & Knoblich, 2016; Yin et al., 2016). This special behavioral pattern also guides individuals to generate and maintain attention to others' behavioral states (Surtees et al., 2016; Tomasello & Carpenter, 2007) and compare others' behavioral states with their own (Meltzoff, 2007), thereby helping children better process and understand others' perceptual states. Jin et al. (2018) showed that coordination level is closely related to 4-year-old children' s tendency to take others' desires: after participating in high-coordination interaction, children were more inclined to choose gifts according to others' desires. However, in Warneken et al.' s (2006) study, no obvious association was found between behavioral coordination and children' s attention to others' behavior.

Both types of characteristics were reflected in this study but were not separated: regarding interaction goal type, in the cooperation group, the action goal was shared between the child and cooperation partner, expressed in plural form as

"we,"while in the competition group, action goals were expressed in singular form as "you" and "I," which had some guiding effect on children' s representation forms; regarding behavioral coordination level, the cooperation group' s fishing rod was connected to their partner' s, while the competition group' s fishing rod was independent of others. Therefore, the current results cannot reveal the specific contributions of the two factors. In this regard, subsequent research needs to further separate the two to gain deeper understanding of the influence mechanism of cooperative interaction.

6 Conclusion

This study experimentally investigated the effect of cooperative interaction on 3-year-old children' s Level 2 perspective-taking ability. The findings show that: (1) Chinese 3-year-old children still have difficulty spontaneously engaging in Level 2 perspective-taking, but already possess the corresponding potential; (2) Short-term cooperative interaction can, to some extent, improve these children's Level 2 perspective-taking level, whereas competitive interaction has no similar effect.

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Level 2 Visual Perspective-Taking at Age 3 and the Effect of Cooperation

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Abstract

Level 2 visual perspective-taking, which is a type of reasoning through which perceptions are formed on the basis of others' perspectives, underlies various social cognitions. Therefore, the development of this type of reasoning attracts considerable attention. The traditional turtle task (Masangkay et al., 1974) indicated that level 2 visual perspective-taking does not emerge until age 4~5. Moll and Meltzoff (2011) introduced a color-filter task and suggested that 3-year-old Western children demonstrate such an understanding. Therefore, our first aim was to investigate 3-year-old Chinese children' s level 2 visual perspective-taking. A crucial aspect concerns how this type of reasoning develops. From a constructivist view, cooperation is supposed to play a crucial role. Numerous studies have provided supporting evidence that cooperation is uniquely related to improvements in perspectival understanding. However, a direct measurement of visual perspective-taking is lacking. Therefore, our second aim was to determine the effect of cooperation on the development of children' s level 2 visual perspective-taking.

The present study performed two experiments. In each experiment, 48 3-year-old Chinese children were randomly assigned to a cooperative or competitive group. Each participant successively received a level 2 visual perspective-taking pre-test, 3-minute cooperative or competitive social interaction according to their group assignment, and level 2 visual perspective-taking post-test. Social interaction involved a fishing game with an experimenter, in which children can collaboratively (cooperation) catch as much fish as they can or catch more fish

than others (competition). Two types of tasks (i.e., experiment 1: turtle task; experiment 2: color-filter task) were used to measure the children's level 2 visual perspective-taking. The pre- and post-tests shared the same task type but used different items.

The children's performance was examined and compared between groups in each experiment. Results showed that (1) 3-year-old Chinese children showed no significant tendency to take level 2 visual perspectives. Experiment 1 indicated that the traditional turtle task was fraught with difficulty for the children. That is, the participants significantly tended to report their own perspective when asked about others' perspective in the pre-test. This result agreed with previous findings that children generally fail this task until age 4. Experiment 2 used a color-filter task. The participants randomly took others' perspective or their own, thereby indicating that they had difficulty taking others' perspectives. (2) Cooperation improved children' s level 2 visual perspective-taking. Experiment 2 found that their level 2 visual perspective-taking was enhanced after cooperation but not after competition. In the post-test, children who cooperated successfully took one another' s perspective, whereas those who competed performed randomly. The difference between groups was significant. Experiment 1 showed the same tendency, but no significance was observed.

Present findings prompt us to update our knowledge of the early development of visual perspective-taking. First, results indicate that 3-year-old children continue to experience difficulty in level 2 visual perspective-taking. Second, cooperation considerably helps children take level 2 visual perspectives. Although children failed to independently take one another' s perspectives, they managed to do so with the help of a preceding task-irrelevant cooperation. This result clarifies the constructive impact of social interaction, thereby suggesting that the ability to take others' perspectives could be specifically enhanced by cooperation. Thus, future studies should focus on the long-term effects of cooperation and how it constructs children's developing representation of visual perspectives.

Key words: young children; level-2 visual perspective-taking; social interaction; cooperation; constructivism.

Note: Figure translations are in progress. See original paper for figures.