Social Cue Preferences and Developmental Characteristics of Group Cognition in Children Aged 3-8

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Abstract

Based on the intuitive theory of social categorization and the concept of group entitativity, this study constructed a typology of material and social cues. Two sub-studies, integrating quantitative and qualitative methods, explored from a social categorization perspective the preferences and developmental trajectory of 3-8-year-old children regarding group cognition cues. The findings revealed that children aged 3-8 generally exhibit a preference for social cues, though the stability of this preference is influenced by the specific cue exemplars selected in the research. Children's preference for social cues increases with age, becoming more pronounced and stable beginning at ages 5-6. These results not only demonstrate the validity of the material and social cue framework but also hold practical value for guiding children's positive social interactions.

Full Text

The Preference and Developmental Characteristics of Societal Cues in 3- to 8-Year-Olds' Group Cognition

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Abstract

Drawing on the intuitive theory of social categorization and the concept of group entitativity, this study constructed a framework of physical-type and societal-type cues. Two sub-studies, combining quantitative and qualitative methods,

explored 3- to 8-year-olds' cue preferences and their developmental trajectories from a social categorization perspective. The findings revealed that children aged 3 to 8 generally exhibit a preference for societal cues, though the stability of this preference was influenced by the specific cue exemplars selected. Children's preference for societal cues increased with age, becoming more pronounced and stable from ages 5 to 6. These results demonstrate the validity of the physical- and societal-type cue framework and hold practical value for guiding positive social interactions among children.

Keywords: 3- to 8-year-old children, group cognition, cue preference, intuitive theory of social categorization, generalized linear mixed model

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1.1 Children's Group Cognition Cues

Children's group cognition encompasses both the perception of group entities and individual members within groups, relying primarily on various cues. Their ability to recognize and process these cues develops remarkably early, emerging around six months of age (e.g., Martin et al., 2002; Kelly et al., 2007). A review of previous research reveals that most studies have focused on social categorization cues within Western cultural contexts, including the "big three" cues—gender, race, and age (Lei et al., 2020; Weisman et al., 2015)—with only a minority examining occupation (Bian et al., 2017), status (Kinzler et al., 2010; Shutts, 2015), and others.

However, these studies have limitations because the concept of groups emphasizes close connections and a sense of unity among members, derived from psychological interdependence and mutual behavioral influence (Lin et al., 2004; Turner, 1981). Consequently, previous research on group cues has not adequately captured the relational characteristics inherent in group concepts. Cues can describe both the existence and categories of groups and differentiate member characteristics and interrelationships, aligning with the scope of group cognition. Therefore, this study refers to cues that reflect these aspects as group cognition cues. Since people also develop ingroup belonging and member interdependence based on social categorization cues (Tajfel & Turner, 1986), group cognition cues also encompass specific social categorization cues.

Recently, researchers have begun examining the role of social relationships within groups in children's group cognition (e.g., Roberts et al., 2017; Switzer et al., 2020). These studies indicate that children's understandable group cognition cues extend beyond traditional social categorization cues. Previous research on intragroup social relationships in children has concentrated on social obligation (Rhodes, 2013) and group norms, both presenting diverse group cognition cues. For instance, when manipulating social obligation within groups, researchers often use members' common interests or goals as cues to examine how children predict member relationships within pre-defined groups (Jordan & Dunham, 2020; Roberts et al., 2017; Switzer et al., 2020). In group

norm research, society or groups impose normative requirements on members regarding traits, behaviors, or beliefs, and these domain-specific norms can also be viewed as cues that determine children's peer interactions (Bian et al., 2017; Roberts et al., 2020; Du & Su, 2005). Thus, children's group cognition cues are not limited to the "big three" and occupation or status cues discussed in traditional social categorization research but also include cues reflecting member social relationships, such as behaviors, interests, and perspectives.

1.2 Classification of Group Cognition Cue Types

Previous classifications of cue types have primarily targeted social categorization cues, distinguishing between natural and social cues, explicit and ambiguous cues, etc. (Wen & Zuo, 2019; Zuo et al., 2019). However, these classifications neither encompass group cognition cues that reflect member social relationships nor provide theoretical elaboration beyond inductive differentiation. In contrast, Rhodes (2013) and colleagues' intuitive theory of social categorization theoretically constructs a framework for children's group cognition, emphasizing children's attention to group social obligations and providing a theoretical foundation for cue type classification.

The intuitive theory posits that children have two innate group cognition tendencies: first, viewing groups as natural kinds, and second, linking groups to social obligations. Regarding the former, children treat group cues as innate and stable structures, often related to physiological attributes. Regarding the latter, children believe group identity or intergroup relationships determine interaction patterns among members, with ingroup members more likely to engage in positive interactions and provide social support (Rhodes & Chalik, 2013). Researchers further note that children's group cognition arises both "bottom-up" from the perceptual foundation of group cues and "top-down" from innate conceptual foundations (Rhodes & Baron, 2019). These tendencies align with essentialist and agentic perspectives (Brewer et al., 2004) or categorical and dynamic perspectives (Rutchick et al., 2008) in group entitativity theory: natural kinds, essentialism, and categoricity emphasize similarity in material or physical attributes among group members, while social obligations, agency, and dynamics focus on social relationships and interdependence patterns (Yang et al., 2012).

Based on previous theories, this study summarizes children's group cognition cue types into physical-type and societal-type cues, corresponding to two group cognition tendencies. Physical-type cues primarily refer to group cues defined by physical characteristics of members themselves or their possessions, including physiological features like the "big three" cues (Weisman et al., 2015; Lei et al., 2020), physical attributes of possessions like clothing color (Chalik & Rhodes, 2014; Jordan & Dunham, 2020), and socioeconomic status defined by the quantity of possessions (Shutts, 2015). Societal-type cues reflect intragroup member relationships, embodying group identity and corresponding to the social essence of group concepts (Lin et al., 2004; Turner, 1981). Accordingly, group belonging

(Platow et al., 2012) can be seen as direct expression of group identity, while previously studied behavioral norms (Foster-Hanson & Rhodes, 2019; Roberts et al., 2020) and common interests (Jordan & Dunham, 2020; Switzer et al., 2020) represent members' spontaneous adherence to group behavioral requirements based on identity.

1.3 Related Research on Children's Group Cognition Cue Preferences and Development

The group concept itself (Lin et al., 2004; Turner, 1981) suggests that social relationships among group members better reflect group essence than similarity in physical characteristics. However, few empirical studies have directly compared the priority of these two aspects in children's group cognition. For instance, research found that with theory-of-mind development, 3- to 4-year-olds rely more on others' emotional states than group identity when inferring social behavior (Chalik et al., 2014), and 4- to 5-year-olds depend more on category-normative traits than group category labels in categorical reasoning (Foster-Hanson & Rhodes, 2019). More studies have focused on single group cues, identifying ages 5 to 6 as a critical period when children learn social norms based on group identity, with others' adherence to social norms across different group identities affecting children's attitudes toward them—verified across physical-type cues like gender (Bian et al., 2017; Wang et al., 2022), race (Dunham et al., 2015), and socioeconomic status (Durante & Fiske, 2017). For these physical-type cues, children's expectations of group members' norm compliance also reflect demands for social-type cues.

Previous empirical research seems to indicate that children may rely more on societal-type cues in group cognition from age 3, aligning with intuitive theory's proposition that children's group cognition depends more on group member relationships than natural categories (Rhodes, 2013). However, the group cues examined in these studies do not fully reflect the physical- and societal-type cue definitions in this research, particularly regarding societal-type cues: previously emphasized normative information within groups (e.g., Bian et al., 2017; Foster-Hanson & Rhodes, 2019) represents only partial manifestation of societal-type cues. Additionally, prior research has limitations in age distribution of child participants. Ages 5 to 6 constitute a critical period for group cognition development (e.g., Bian et al., 2017; Durante & Fiske, 2017; Roberts, 2021; Roberts et al., 2020), and although studies have found differences in ingroup behavior learning between 4- to 5-year-olds and 7- to 8-year-olds (Wilks et al., 2019), few have systematically explored developmental patterns across a continuous age range spanning 5 to 6 years. Finally, previous studies often paired group physical differences with group labels while using specific behaviors to reflect group sociality (e.g., Bian et al., 2018; Switzer et al., 2020). This manipulation overlooks weight differences between visual group labels and behavioral patterns in people's group cognition, especially when behavioral patterns are understood as individuation information (see discussions in Fiske & Neuberg, 1990; Monroe

et al., 2018).

1.4 Current Research

In summary, this study distinguishes physical- and societal-type cues, focusing on children's cue preferences between these two types and their development during group cognition. Considering that social categorization represents the initial stage of group cognition and attitude formation (Bigler & Liben, 2007; Tajfel & Turner, 1986; Wen & Zuo, 2019), and that related paradigms are widely applied in child research (e.g., Coley, 2012; Xu et al., 2022), this study adopts social categorization paradigms to explore research questions.

Previous research indicates that children around age 3 begin actively demonstrating social categorization behavior, with intergroup attitudes developing rapidly thereafter (Rhodes & Baron, 2019; Wang et al., 2022). The literature review also suggests the necessity of spanning the critical period of age 5 to 6 for acquiring group social norms to systematically explore developmental patterns in cue-type preferences. Therefore, this study sets age 3 as the starting point, using two-year intervals (Jordan & Dunham, 2020), focusing on three age groups: 3- to 4-year-olds, 5- to 6-year-olds, and 7- to 8-year-olds.

This study comprises two sub-studies. Study 1 uses triad classification and exclusion tasks to explore cue preferences and development in 3- to 8-year-olds. Study 2 employs an open-ended social categorization task to further explore cue preferences and underlying reasons using a more ecologically valid method.

Based on theoretical and empirical reviews, children exhibit societal cue preferences from age 3 (Chalik et al., 2014; Rhodes, 2013). However, considering that the critical period for acquiring group social norms occurs at ages 5 to 6 (Durante & Fiske, 2017; Roberts, 2021), and that learning behaviors based on ingroup/outgroup distinctions show different characteristics before and after this age (Wilks et al., 2019), we predict that children's cue preferences will further develop between ages 3 and 8. Regarding our research questions on children's cue-type preferences and development, specific hypotheses are as follows:

Hypothesis 1: Overall, 3- to 8-year-olds prefer societal-type cues over physical-type cues.

Hypothesis 2: Children's preference for societal-type cues develops between ages 3 and 8, becoming more pronounced and stable from age 5 to 6.

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2 Study 1: Experimental Examination of Children's Group Cognition Cue Preferences and Development

Study 1 explored cue preferences and development in 3- to 8-year-olds through two experimental tasks. The triad classification task is a classic method for examining cue priority (e.g., Coley, 2012; Xu et al., 2022). The exclusion task,

based on framing effect principles (De Martino et al., 2006; Li & Tan, 2018), was designed with reference to the triad classification task, focusing on children's cue-type preferences under "exclusion" rather than "selection" framing.

2.1.1 Participants

All experimental procedures were approved by ethics review, with informed consent obtained from children, their teachers, and parents. Study 1 treated age group and gender as independent variables. Using G*Power 3.1 software for F-tests (ANOVA: Fixed effects, special, main effects and interactions), we calculated required sample size with effect size set at 0.25, significance level at 0.05, numerator degrees of freedom at 2, finding that 158 participants were needed to achieve 0.80 statistical power.

Study 1 experiments were conducted online via Wenjuanxing platform based on offline pilot testing. To ensure adequate sample size, we increased recruitment for each age group (minimum 70 participants with balanced gender), ultimately recruiting 242 children (ages 3.33 to 8.40) from kindergartens through second grade in Huainan City, Anhui Province. Fourteen children did not provide valid birthdates; researchers assigned age groups based on grade: kindergarten small and middle class children (5) to the 3- to 4-year-old group; kindergarten large class through first grade children (8) to the 5- to 6-year-old group; and second grade children (1) to the 7- to 8-year-old group.

To ensure online response validity, six attention check questions were included to verify children's understanding of various cues. Three children answering two or more questions incorrectly were excluded for failing attention checks. Considering that some parents might respond on behalf of children when experiments were distributed through teachers, researchers screened responses based on completion time using offline pilot data as reference. After excluding 24 responses with completion times under 300 seconds, we obtained a valid sample of 215 participants (median completion time: 755.5 seconds; mean: 903.9 seconds for 27 items). The final sample included 68 children ages 3-4 (35 boys, Mage = 4.08, SD = 0.46), 76 children ages 5-6 (37 boys, Mage = 5.98, SD = 0.60), and 71 children ages 7-8 (36 boys, Mage = 7.69, SD = 0.38).

2.1.2 Experimental Materials

To facilitate children's understanding and memory, group cue exemplars were presented as simple line drawings [Figure 1: see original paper]. To maximize generalizability, we selected cue exemplars that could best represent physical- and societal-type cues while minimizing homogeneity within cue types. Physical-type cues included T-shirt color (Jordan & Dunham, 2020), gender (Martin et al., 2002), and socioeconomic status (Shutts, 2015). Societal-type cues included group belonging (Platow et al., 2012), common interest (Switzer et al., 2020), and group norms (Roberts et al., 2020). According to our definitions, gender represents physiological features; T-shirt color represents physical attributes of

possessions; socioeconomic status reflects material quantity; group belonging demonstrates member identification; common interest reflects shared attitudes; and group norms represent behavioral consistency based on group identity.

[Figure 1: see original paper] Schematic diagram of experimental materials

Due to gender-stereotyped color associations (Weisgram et al., 2014), we pretested 56 kindergarten children (28 girls, Mage = 4.91, SD = 0.89, range 3.00-6.62) on gendered judgments of 12 colors, selecting orange (RGB: 255, 165, 0) and white as neutral colors (ps > 0.789). Socioeconomic status was represented by houses, with instructions and recognition checks ensuring children's comprehension of the housing patterns representing high and low status [FIGURE:1-].

Societal-type cues were presented as icons. Group norm cues selected two common behavioral rules for young children: not jumping around in class and not talking to others in class [FIGURE:1-]. Common interest cues were manipulated through ball sports: soccer and basketball [FIGURE:1-]. Group belonging indicated class membership (Class A vs. Class B) [FIGURE:1-], referred to as "big class" and "small class" in instructions.

2.1.3 Experimental Design

The experiment employed a 3 (age: 3-4, 5-6, 7-8) × 3 (physical-type cue: color, gender, socioeconomic status) × 3 (societal-type cue: norm, belonging, interest) mixed design, with age as a between-subjects variable and the nine combinations of physical- and societal-type cues as within-subjects variables. The dependent variable was children's cue selection in experimental tasks.

2.1.4 Experimental Procedure

Due to online implementation and limited text-reading ability, experiments were administered with parental assistance. To minimize parental interference, materials were presented in child-friendly ways that reduced assistance difficulty. The informed consent emphasized children's independent responding, instructing parents to only read instructions while children made selections. Instructions were differentiated: explanations for parents and child-directed instructions requiring parental reading. Three kindergarten parents were consulted to refine child-directed instructions.

The formal procedure comprised two phases. First, a learning phase where children learned all group cue exemplars and corresponding character features, with two characters presented per single cue. For gender, after introducing both characters' genders, children answered: "Which one is the boy and which is the girl?"[1]—selecting each character's group (attention check). Cue learning order was randomized across participants.

Second, the formal experiment administered triad classification and exclusion tasks in random order across children. In each triad classification trial, children saw two target characters and one reference character, with targets differing

from the reference on either physical- or societal-type cues [Figure 2: see original paper]. Target positions were randomized. Children judged which target better grouped with the reference, with selections reflecting cue preferences. Choosing the target sharing societal-type cues with the reference scored 1 point; otherwise 0.

Sample instructions: "Here are three different children. #1 wears white clothes and doesn't talk to others in class. #2 wears yellow clothes and doesn't jump around in class. #3 wears white clothes and doesn't jump around in class. Would you rather group child #3 with #1 or #2?" [Figure 2: see original paper] Schematic diagram of triad classification task (color × norm condition)

Unlike triad classification, exclusion tasks presented four characters in random positions, with two sharing both physical- and societal-type cues as reference characters. For color × norm condition, this included two reference characters sharing both cues [FIGURE:3- ,], target 1 differing on norm [FIGURE:3-], and target 2 differing on color [FIGURE:3-]. Children selected the person not belonging to the group: "Here are four children in a line. Their clothing colors and classroom behaviors differ slightly. One child is in the wrong line. Who is it?" Selecting target 1 indicated societal cue preference (scored 1); selecting target 2 indicated physical cue preference (scored 0).

Both tasks included nine conditions: color × norm, color × belonging, color × interest, gender × norm, gender × belonging, gender × interest, socioeconomic status × norm, socioeconomic status × belonging, and socioeconomic status × interest, with one trial per condition. Trial order was randomized across participants.

2.1.5 Data Analysis Methods

To measure each child's societal cue preference, we calculated the proportion of societal cue selections in each task as preference scores (Coley, 2012), with higher values indicating stronger preference. However, pilot testing revealed that young children might select reference characters due to position or personal preference rather than cues. If counted as valid, these trials would artificially deflate societal preference scores. Therefore, trials where children selected reference characters were coded as missing values. Twenty children made such selections (1-5 times each); across 1,926 total selections, 41 trials (2.13%) were missing.

Preliminary analyses showed non-significant gender effects across all conditions. Therefore, primary analyses focused on age-preference relationships. Using SPSS 27.0, we first conducted one-way ANOVA and general linear models on societal preference scores to examine age-related trends.

Second, we used generalized linear mixed models (GLMM) in R 4.1.3 with the lme4 package (Bates et al., 2014) to analyze cue selection (0/1 coded) as the outcome variable, with age (continuous), physical-type cue, societal-type cue,

and their interactions with age as predictors, plus random intercepts for participants. Satterthwaite approximations from the lmerTest package (Kuznetsova et al., 2017) provided p-values. We then examined each of the nine conditions separately using logistic regression in SPSS 27.0 to assess age effects on cue selection.

Finally, we used binomial tests to examine cue preferences within each age group across conditions, with chi-square tests comparing age groups to identify critical developmental periods, applying Bonferroni corrections for multiple comparisons.

2.2.1 Developmental Trends in Children's Societal Cue Preference Scores

Treating age as a categorical variable, one-way ANOVA revealed non-significant main effects of age on societal cue preference scores in both tasks, $F(2, 212) < 1.21$, $p > 0.302$, $p^2 < 0.012$. Comparing preference scores to chance level (0.5) showed that children across all ages and tasks demonstrated societal cue preferences, ts > 3.02, ps < 0.005.

Treating age as a continuous variable, regression analyses showed that age did not significantly predict societal preference scores in the triad classification task, $\beta = 0.11$, $t = 1.53$, $p = 0.128$. However, in the exclusion task, the relationship was marginally significant, $\beta = 0.13$, $t = 1.86$, $p = 0.064$, indicating stronger societal cue preference with increasing age [Figure 4: see original paper].

[Figure 4: see original paper] Relationship between children's age and overall societal cue preference scores

2.2.2 Developmental Trends in Children's Cue Selection

GLMM coefficients are presented in Table 1. Model fit indices for triad classification were: AIC = 1808.2, BIC = 1868.6, LL = -893.1; for exclusion: AIC = 1755.3, BIC = 1815.6, LL = -866.6. The model explained 24% of variance in triad classification and 46% in exclusion, indicating better explanatory power for the exclusion task.

GLMM results predicting children's cue selection from age, physical-type, and societal-type cues

Consistent with preference scores, age effects on cue selection were non-significant in triad classification but significant in exclusion. In triad classification, belonging and interest cues differed significantly from norm cues. Interaction effects showed that with age, belonging predicted societal cue selection more strongly than norms. In exclusion, gender and socioeconomic status differed from color; interest differed from norm. Interactions indicated that socioeconomic status predicted physical cue selection more strongly than color with increasing age. Thus, GLMMs confirmed stronger age effects

in exclusion than triad classification, while also revealing that selected cue exemplars influenced children's choices.

To comprehensively examine age effects, we conducted logistic regressions for each condition. In triad classification, age effects were significant for color × belonging ($R^2 = 0.109$) and socioeconomic status × belonging ($R^2 = 0.030$), with coefficients $B = 0.46$, SE = 0.13, Wald = 12.55, $p < 0.001$, and $B = 0.20$, SE = 0.10, Wald = 4.21, $p = 0.040$, respectively. Other conditions showed non-significant age effects ($R^2 < 0.019$). In exclusion, age effects were significant for color × norm ($R^2 = 0.054$) and gender × belonging ($R^2 = 0.033$), with coefficients $B = 0.28$, SE = 0.10, Wald = 7.76, $p = 0.005$, and $B = 0.21$, SE = 0.10, Wald = 4.68, $p = 0.030$, respectively. Other conditions were non-significant ($R^2 < 0.023$). In all significant conditions, age positively predicted societal cue selection, indicating increasing societal cue preference with age.

2.2.3 Cue-Type Preferences Across Age Groups and Conditions

We analyzed specific cue preferences within each age group. With nine conditions, rejecting the null hypothesis in any condition increased Type I error risk, so we applied Bonferroni correction, adjusting significance level from 0.05 to 0.006 (0.05/9) (Bender & Lange, 2001; Wang et al., 2022).

Binomial test results are shown in Table 2. In triad classification, children showed societal cue preferences in 5, 8, and 7 conditions for ages 3-4, 5-6, and 7-8, respectively. In exclusion, preferences appeared in 3, 5, and 8 conditions, respectively.

Children's societal cue preferences in triad classification and exclusion tasks

Chi-square tests comparing age groups (corrected $p = 0.017$) revealed that in triad classification, for color × belonging, significant differences emerged between 3- to 4-year-olds and both older groups, $^2 > 6.84$, ps < 0.001, ϕs > 0.23, while 5- to 6- and 7- to 8-year-olds did not differ, $^2 < 0.01$, $p > 0.999$. For socioeconomic status × belonging, although logistic regression showed positive age effects, between-group differences were non-significant, ^{2}s < 4.01, ps > 0.045.

In exclusion, for color × norm, 3- to 4-year-olds used societal cues significantly less than 7- to 8-year-olds, $^2 = 8.84$, $p = 0.002$, $\phi = 0.27$; other pairwise differences were non-significant, ^{2}s < 3.41, ps > 0.065. For gender × belonging, despite positive age effects in logistic regression, between-group differences were non-significant, ^{2}s < 3.41, ps > 0.093.

2.3 Discussion

Online administration of triad classification and exclusion tasks revealed that 3- to 8-year-olds preferred societal over physical cues in both tasks. Societal preference scores and specific condition selections showed that age positively predicted societal cue selection and preference in exclusion but not triad classification. After separating conditions, age-related societal cue preferences emerged

in triad classification for color × belonging and socioeconomic status × belonging, and in exclusion for color × norm and gender × belonging. Comparisons across age groups showed that older children demonstrated societal preferences in more conditions than younger children, particularly in exclusion. In triad classification color × belonging and exclusion color × norm conditions, 7- to 8-year-olds were more likely than 3- to 4-year-olds to apply societal cues.

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3 Study 2: Qualitative-Quantitative Investigation of Children's Group Cognition Cue Preferences and Development

To enhance ecological validity, Study 2 used an open-ended social categorization task with multiple simultaneously presented cues, combined with observational methods, to further explore children's cue preferences and underlying reasons.

3.1 Methods

The open-ended social categorization task resembles the Dimensional Change Card Sort (DCCS; Zelazo, 2006), but uses characters instead of objects. To differentiate from Study 1 while controlling task difficulty, Study 2 presented three group cue exemplars (both physical- and societal-type) per trial. Although six cues could form nine combinations, we considered representativeness and importance, grouping gender (Martin et al., 2002), color (widely used in minimal group paradigms, e.g., Chalik & Rhodes, 2014; Jordan & Dunham, 2020), and norms (frequently mentioned in group cognition research, e.g., Foster-Hanson & Rhodes, 2019; Roberts, 2021) together, with remaining cues forming another group, creating two experimental conditions.

3.1.1 Participants

Study 2 was conducted in familiar kindergarten settings. Referencing qualitative saturation guidelines (12 samples yield 92% of codes; 16-24 samples achieve meaning saturation) (Yang et al., 2022), we planned to recruit 20 participants per age group, increasing the 3- to 4-year-old sample due to limited language abilities. After excluding three children (all 3- to 4-year-olds) who failed to understand instructions or provide valid responses, we obtained 73 participants: 32 ages 3-4 (13 boys, Mage = 4.31, SD = 0.38), 21 ages 5-6 (11 boys, Mage = 5.78, SD = 0.57), and 20 ages 7-8 (9 boys, Mage = 8.11, SD = 0.53). Some children did not complete all tasks due to scheduling, resulting in slight variations in sample sizes across analyses.

3.1.2 Design

The study used a 3 (age: 3-4, 5-6, 7-8) × 2 (condition: color × gender × norm vs. socioeconomic status × belonging × interest) mixed design, with age

as between-subjects and condition as within-subjects. Dependent variables included: (1) cue type selected during first valid classification (using one of six cues); (2) number of cues used during classification; and (3) reasons and behavioral manifestations of valid classifications.

3.1.3 Materials

Materials were identical to Study 1 but recombined according to conditions, with each set containing eight character cards for classification, where any two characters differed on at least one cue.

3.1.4 Procedure

A female researcher administered the open-ended social categorization task with follow-up questions, video-recording children's behavior. Each session lasted approximately 10 minutes. Conditions were presented in random order. Using color × gender × norm as an example:

The researcher randomly placed eight character pictures, then guided children to notice three embedded cues, introducing each in random order. For gender: "Here are eight different children. Can you tell me which are boys and which are girls?" Correct responses proceeded to the next cue; errors prompted reintroduction (maximum three repetitions).

Children then classified all characters into two groups (eight-person task) without restrictions on cues or group size, up to three times. Instructions: "If you had to divide these eight children into two groups, how would you do it?" If unclear, the researcher clarified: "Dividing into two groups means separating them to two sides." Most children completed this successfully. If children used the same cue across consecutive classifications, the task ended, indicating inability to apply alternative cues.

Additionally, to accommodate young children's limited attention, an unbalanced five-person task followed, randomly selecting five characters (2:3 ratio across three cues) for more ecologically valid preference assessment.

After each classification, researchers recorded the basis and reason: "Why did you group them this way?"

3.1.5 Data Analysis Methods

(1) Quantitative Analysis

Using SPSS 27.0, we first conducted chi-square tests on contingency tables to examine cue preferences and age differences across tasks. Second, we analyzed the number of cues used in the eight-person task using Kruskal-Wallis H tests to assess age effects.

(2) Qualitative Analysis

Qualitative data collection followed structured observation requirements. From an ethnomethodological perspective, observation reveals not only content but also underlying psychological mechanisms (Chen, 2000). Data were collected through immediate notes and video recordings, with recordings validating notes and enabling behavioral observation. After reviewing all recordings, we identified valid observational sources from 29 three- to four-year-olds (13 boys, 16 girls) and all 5- to 8-year-olds.

The qualitative process involved: 1. **Material compilation**: Researchers integrated immediate notes and recordings, transcribing children's cue selections, behaviors, and reasons. A psychology undergraduate unfamiliar with the study's purpose verified all transcripts. Texts were organized by three age groups (3-4 vs. 5-6 vs. 7-8). 2. **Coding**: Using NVivo 11.0, we coded behaviors and verbal explanations, focusing on both classification behavior and language to extract preferences and reasons. Following Burkholder et al. (2021), we reported proportions of coded categories relative to total entries. 3. **Reliability**: A PhD student experienced in qualitative research reviewed coding, identifying ambiguous or overlapping categories. Most codes were approved; minor disputes were resolved through discussion, yielding high reliability.

3.2.1 First Classification Cue Preferences

Analysis of children's first valid classification cue selection showed significant age differences in color × gender × norm condition for both eight-person, $^2(4) = 11.34$, $p = 0.023$, $\phi = 0.44$, and five-person tasks, $^2(4) = 14.90$, $p = 0.005$, $\phi = 0.50$. Post-hoc power analysis using G*Power 3.1 (^{2} *goodness-of-fit) with* N* $= 73$, $df = 4$, yielded approximately 0.80 power for both tasks.

Further analysis revealed differences primarily between 3- to 4-year-olds and 5- to 6-year-olds, $^2(2) > 8.34$, $p < 0.016$, $C > 0.419$. Specifically, 3- to 4-year-olds preferred physical cues, particularly gender (eight-person: $^2(2) = 6.70$, $p = 0.035$, $C = 0.10$; five-person: $^2(2) = 19.18$, $p < 0.001$, $C = 0.11$). Five- to 6- and 7- to 8-year-olds showed no significant preferences, $^2(2) < 4.34$, $p > 0.114$.

In socioeconomic status × belonging × interest condition, age and cue selection were not significantly associated [Figure 6: see original paper], $^2(4) < 7.29$, $p > 0.121$, $r < 0.34$. However, within-age analyses showed 3- to 4-year-olds preferred socioeconomic status cues in both eight-person ($^2(2) = 8.33$, $p = 0.016$, $C = 0.11$) and five-person tasks ($^2(2) = 7.68$, $p = 0.021$, $C = 0.10$). Five- to 6- and 7- to 8-year-olds showed no significant preferences, $^2(2) < 1.60$, $p > 0.449$.

3.2.2 Age Differences in Number of Effective Classifications

Wilcoxon signed-rank tests revealed non-significant condition effects on classification numbers across age groups, Zs < 0.94, ps > 0.34.

Age effects on number of cues used were significant across both conditions, Hs > 37.97, ps < 0.001. Five- to 6-year-olds used significantly more cues (color ×

gender × norm: $M = 1.90$, $SD = 0.97$; socioeconomic status × belonging × interest: $M = 2.05$, $SD = 1.00$) than 3- to 4-year-olds ($M = 0.85$, $SD = 0.66$; $M = 1.71$, $SD = 0.99$), Zs > 3.23, ps < 0.002. All 7- to 8-year-olds used three cues, significantly more than younger groups, Zs > 3.59, ps < 0.001.

3.2.3 Children's Classification Reasons

We identified 356 valid classifications and 404 valid reasons. Qualitative analysis coded these into two categories: classification cues and individual preferences.

(1) Classification Cues

Most children classified based on similarity across cue exemplars, representing the primary reason: 72.36% of 3- to 4-year-olds' reasons (89/113), 86.26% of 5- to 6-year-olds' (113/131), and 100% of 7- to 8-year-olds' (160/160). We further coded these as:

- **Concrete features**: Listing specific character features visible in pictures (e.g., "These four are white," 4-year-old girl; "Boys wear pants, girls don't," 4-year-old boy; "I grouped by jumping and this mouth," 6-year-old boy).
- **Abstract concepts**: Using cue names or summary features (e.g., "They all have the same house," 4-year-old girl; "Although their clothes differ, their marks are the same," 5-year-old girl; "Group by gender," 6-year-old boy; "Group by class," 7-year-old girl).

Comparing proportions within the "classification cues" category, age differences between 3- to 4-year-olds and older groups were significant, $^2(1) > 27.15$, ps < 0.001. Three- to 4-year-olds predominantly used concrete features (75/89, 84.27%), $^2(1) = 41.81$, $p < 0.001$, $C = 0.05$, whereas 5- to 6- and 7- to 8-year-olds used concrete features (47.79% and 47.50%) and abstract concepts equally.

(2) Individual Preferences

Beyond cue exemplars, children also classified based on position features, emotional attitudes, and fairness considerations.

- **Position features**: Classifying based on picture arrangement, primarily in 3- to 4-year-olds (33.33% of behaviors) and 5- to 6-year-olds (17.17%). This included direct position-based grouping or treating position changes as new classification methods [Figure 7: see original paper].
- **Emotional attitudes**: Incorporating speculations about intra-group/intergroup relationships or personal feelings (e.g., "They three will play happily together"; "Boys and girls mixing together is not good"; "They can improve their weaknesses together"). This accounted for 11.38%, 16.79%, and 2.5% of reasons across age groups.
- **Fairness needs**: Balancing classification methods across features or trials (e.g., "She's a girl and he's a boy, so they go together"; "Now it's his turn to lead"). This represented 6.19%, 6.11%, and 1.25% of reasons, with

symmetrical card placement reflecting fairness concerns in 8.13%, 9.49%, and 6.25% of behaviors [Figure 8: see original paper].

3.3 Discussion

The open-ended social categorization task revealed different cue preferences across age groups, with significant age effects in the color × gender × norm condition: 3- to 4-year-olds preferred physical cues (gender and socioeconomic status), while 5- to 6- and 7- to 8-year-olds showed no significant preferences. Additionally, 5- to 6- and 7- to 8-year-olds used more classification cues than 3- to 4-year-olds, demonstrating greater flexibility. Finally, 3- to 4-year-olds more often described concrete features and used position-based classification, while all age groups exhibited "fairness" characteristics in language and behavior.

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4 General Discussion

Combining experimental and observational methods, this study explored cue preferences, development, and underlying reasons in 3- to 8-year-olds' group cognition. We identified a societal cue preference that strengthens with age, though its stability was influenced by specific cue contexts. These findings demonstrate the application and developmental trajectory of societal cues in early group cognition, highlighting the foundational roles of both "top-down" psychological constructs and "bottom-up" perceptual information. The physical- and societal-type cue framework offers a novel perspective for group cognition research and children's group concept development.

4.1 Children's Societal Cue Preferences Are Influenced by Cue Context

Both sub-studies demonstrated that 3- to 8-year-olds could comprehend and apply physical- and societal-type cues across tasks. Study 1 found societal preference scores above chance levels, corroborating previous research that children value social information reflecting group essence over physical attribute similarity (e.g., Chalik & Rhodes, 2014; Foster-Hanson & Rhodes, 2019). In both tasks, innate constructs about social information may play a more important role than perceptual processing of physical group information (Rhodes & Baron, 2019).

However, results also showed that societal cue preferences were unstable, with inconsistent findings across methods. Study 1 revealed differing main and interaction effects across tasks, while Study 2 showed stronger physical cue preferences. These discrepancies reflect framing effects (De Martino et al., 2006; Li & Tan, 2018) and potential combined influences of cue quantity, content, and administration method.

Study 1 tasks forced choices between two cue types, echoing previous comparisons of group labels versus behaviors (e.g., Bian et al., 2018; Chalik et al., 2014) and corresponding to intuitive theory's natural category-obligation dichotomy (Rhodes, 2013). Study 2 simultaneously presented three cues for autonomous selection, potentially eliciting different strategies. The additional options increased cognitive load, especially for younger children (Bigler & Liben, 2007), while the salience of gender and socioeconomic status cues made them more prominent (Rhodes & Baron, 2019; Shutts, 2015). Consequently, open-ended classification yielded more physical cue preferences than forced-choice tasks.

Together, Hypothesis 1 was partially supported: while children showed societal cue preferences, their expression was sensitive to cue combination contexts and paradigms. The selected exemplars influenced choices while demonstrating within-type heterogeneity, and societal preferences across conditions suggest broad applicability. Future research should employ more diverse cue presentations and big data methods (e.g., Hebart et al., 2020) to better isolate cue-type preferences from exemplar effects.

4.2 Societal Cue Preferences Become More Stable in Older Age Groups

Developmental patterns differed across cue contexts. Societal preference scores and cue selection analyses revealed stronger age effects in exclusion versus triad classification: preferences increased with age. Across significant conditions, age positively predicted societal cue selection. Older children showed societal preferences in more conditions than younger children, particularly in exclusion. In Study 2, age effects emerged between 3- to 4- and 5- to 6-year-olds in color $\times$ gender $\times$ norm: 3- to 4-year-olds preferred physical cues, while older groups showed no preferences. Thus, Hypothesis 2 was partially supported—societal preferences were not stable from ages 3 to 8 but became more pronounced and stable after age 5 to 6.

Three- to 4-year-olds' preferences varied substantially across paradigms, particularly between Studies 1 and 2. Their physical cue preference in open-ended tasks underscores the foundational role of visual information in early group cognition, confirming the importance of "big three" cues (Kinzler et al., 2010; Lei et al., 2020; Weisman et al., 2015). Visual salience is a prerequisite for group cognition, with infants as young as six months identifying groups by visual features (Rhodes & Baron, 2019). When encountering new social targets, young children likely associate them with visually salient cues like gender, building group cue knowledge (Bigler & Liben, 2007). Our findings suggest visual salience-based cognition remains influential through age 3-4, determining classification strategies when autonomous selection is required.

Age differences primarily emerged between 3- to 4- and 5- to 6-year-olds, corresponding to the critical period for group cognition development (Bian et al., 2017; Dunham et al., 2015; Durante & Fiske, 2017). Societal-type cues, con-

structed from group concepts, better reflect members' belonging and participation (Turner, 1981; Lin et al., 2004). Comparing 5- to 6-year-olds' preferences across studies suggests their societal cue cognition may shift from intuitive processing of group obligations (Rhodes, 2013) to valuing group relationship essence, consciously applying societal cues in open-ended tasks. This transition may be influenced by theory-of-mind development (Chalik et al., 2014). Future research should explore underlying psychological mechanisms to better understand human social development. Finally, 7- to 8-year-olds' more stable societal preferences reflect genuine recognition of societal cues' importance, less susceptible to environmental influence.

4.3 Theoretical Innovation and Application Value

What groups exist in social life, and what roles do they play? Previous research addressed these questions using only a few specific identities (e.g., gender, status), rarely considering group characteristics themselves. The physical- and societal-type cue framework helps comprehensively depict group cognition patterns. Theoretically, intuitive theory (Rhodes, 2013; Rhodes & Chalik, 2013) and entitativity theory (Brewer et al., 2004; Rutchick et al., 2008) both identify two aspects: physical similarity among members and social connections within groups. This study formalizes these as physical- and societal-type cues, validating the framework empirically. Physical-type cues are defined by perceptible attributes of people or possessions; societal-type cues are defined by intragroup social relationships linked to group identity. These correspond to "bottom-up" perceptual and "top-down" conceptual foundations (Rhodes & Baron, 2019).

Future research should clarify relationships between this framework and other group features (e.g., entitativity), examine whether physical and societal dimensions are opposite ends of one dimension or two separate dimensions, and identify corresponding psychological structures. Longitudinal studies could explore developmental changes in physical and societal cognition. Such work would advance understanding of human social nature from a group characteristics perspective.

Practically, these findings guide children's peer interactions. Early group cognition relates to later stereotype formation (Bigler & Liben, 2007). Educating children about group cognition strategies at appropriate ages can prevent stereotyped thinking. Ages 5 to 6 represent a critical period for societal cognition development. Before this, adults should guide children not to overemphasize physical cues; after this period, they should foster more open and flexible group concepts.

4.4 Limitations and Future Directions

This study innovatively proposes the physical- and societal-type cue framework and explores 3- to 8-year-olds' group cognition cue preferences, significantly

contributing to understanding developmental patterns. However, several limitations remain.

First, online versus offline administration may have contributed to sub-study differences. Online methods may substantially affect 3- to 4-year-olds (Lapidow et al., 2021). Although we ensured validity through instruction design, simplified content, and time screening, online interference cannot be fully excluded. Study 1 results for 3- to 4-year-olds should be interpreted cautiously. Future research should employ traditional offline methods or develop improved online approaches (e.g., video data collection; Rhodes et al., 2020) to validate current findings.

Second, this study primarily adopted a social categorization perspective with only six cue exemplars, and Study 2 did not include all possible combinations. Given that specific cue contexts influence preferences, we cannot quantify the exact impact of combination methods. Future studies should select more exemplars, create more ecologically valid social stimuli, and move beyond social categorization methods to systematically explore cue-type preferences and development.

Finally, considering our findings on classification reasons (e.g., position features, fairness needs), future research should examine how experimental material organization and individual characteristics influence cue-type preferences, providing more detailed investigation of external and internal mechanisms affecting children's group cognition development.

Conclusions

1. Overall, 3- to 8-year-olds exhibit societal cue preferences, though specific cue combination contexts influence preference expression.
2. Children's societal cue preferences increase with age between 3 and 8, becoming more stable and pronounced after age 5 to 6.

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