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How Preschoolers use cues of dominance to make sense of their social environment

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Abstract

A series of four experiments investigated preschoolers' abilities to make sense of dominance relations. Experiments 1 and 2 showed that preschoolers are able, as early as 3 years old, to infer dominance not only from physical supremacy but also from decision power, age, and resources. Experiments 3 and 4 showed that preschoolers have expectations regarding the ways in which a dominant and subordinate individual are likely to differ. In particular, they expect that an individual who imposes his choice on another will exhibit higher competence in games and will have more resources.

KEYWORDS: Dominance cues; Preschool; Social Cognition; Folk Sociology

HOW PRESCHOOLERS USE CUES OF DOMINANCE TO MAKE SENSE OF THEIR SOCIAL ENVIRONMENT

A critical factor that structures the social relations of many species, including humans, is *dominance*. An individual A is dominant over B if, when a conflict occurs between them, A is more likely to win than B. A and B have an established dominance relation when both behave in a way that takes this asymmetry into account (Bernstein, 1981; Drews, 1993). Consequently to this state of affairs, dominance is commonly characterized as a social position that determines access to desired and limited resources, such as food, territory, or mates: the dominant individual is the one who has a priority of access to resources over the subordinate individual (Hawley, 1999; Popp & DeVore, 1979). The central role played by dominance in social regulation (Cummins, 1996; Fiske, 1992) makes the understanding of dominance relations crucial to engage in appropriate social behavior (Hausfater, 1975; Moors & De Houwer, 2005).

Compared to the abundant literature in social psychology (Bente, Leuschner, Issa, & Blascovich, 2010; Dunbar & Burgoon, 2005; Sidanius, 2001), experimental research in developmental psychology on this topic is surprisingly scarce, even though dominance is an important factor in social life from very early on. Developmental studies on social cognition have mainly focused on mindreading while dominance relations were studied in human ethology. By describing agonistic encounters among peers, ethological studies have established that, beginning in their second year of life, children form fairly stable and transitive dominance hierarchies (Russon & Waite, 1991; Strayer & Strayer, 1976). These studies provide a rich picture of the dominance structures in groups of preschoolers, but they do not describe the cognitive mechanisms underlying the processing of dominance relations.

The assessment of dominance requires the ability to detect who is dominant and who is subordinate, to interpret situations in which dominance is established and to anticipate the outcomes of interactions between dominant and subordinate individuals. Early studies failed to demonstrate preschooler's ability to understand dominance relations. Children were either asked to compare their own toughness relative to individual peers (Edelman & Omark, 1973; Omark & Edelman, 1975; Omark, Omark, & Edelman, 1975) or to rank-order their entire group on a toughness scale Sluckin & Smith, 1977; Strayer, Chapeskie, & Strayer, 1978). The poor performance observed could be accounted for by the complexity of the tasks (due to the large number of potential relationships to consider see Strayer et al., 1978, p.187), and by the tendency to overestimate one's own dominance status and the status of liked peers (Strayer et al., 1978; Boulton & Smith, 1990).

More recently a study did find evidence for sensitivity to dominance in infants as young as 10 months (Thomsen, Frankenhuis, Ingold-Smith, & Carey, 2011). These results suggest that infants begin to form expectations about the outcomes of conflict situations based on the entities' relative body sizes. In particular, infants looked longer when a larger agent bowed, retracted, and allowed a smaller agent to pursue its goal. In a related experiment, Mascaro & Csibra (2012) observed that 15-month-old infants looked longer when an agent that had prevailed over another in a specific conflict situation did not prevail in a different conflict situation (see also Mascaro & Csibra, 2013).

The present experiments extend these findings in three ways. First, contrary to infant studies, they evaluate explicit knowledge of dominance. A gap of several years has already been observed between implicit and explicit success in some tasks. Most famously, 15-months-old infants have been shown to look longer at an agent who does not act in line with her beliefs than at one who does, even if these beliefs are false (Onishi & Baillargeon, 2005), suggesting that preverbal infants can solve an implicit version of the false belief task (see also Surian, Caldi, & Sperber, 2007). A recent study suggests that 6-months-old infants generate action predictions on the basis of other agents' beliefs (Southgate & Vernetti, 2014). By contrast, the ability to provide the correct answer to standard, explicit false belief tasks only emerges around 4 years of age (See Wellman, Cross, & Watson, 2001). Similarly, children's implicit understanding of dominance relations does not necessarily imply an ability to make explicit judgments of dominance.

Second, the identification of dominance relations would be of limited scope if it did not allow children to draw inferences about how dominance influences social interactions and to predict how dominant and subordinate individuals are likely to differ on a range of characteristics. By studying two different conflict situations, Mascaro and Csibra (2012) demonstrated that infants draw some generalizations from dominance relations. However, more abstract generalizations regarding how the dominant differs from the subordinate can also be tested. Imagine a situation in which one individual—alpha—gives orders to an individual who complies—beta. This signals that a dominance relation between alpha and beta has been established. Children might have expectations regarding a number of asymmetries that could be entailed by this dominance relation, for example, they might

expect alpha to be superior to beta in dominance relevant situations such as competitive games or resource holding.

Third, infant studies show that dominance is perceived in conflict situations that involve physical superiority (e.g., physically imposing oneself through one's body size) or agonistic behavior (e.g., pushing a rival). However, dominance is also expressed in relatively subtle asymmetries that do not necessarily involve coercion or agonistic interactions (Hawley, 1999). Indeed, as children grow older or become more familiar with the group, the rate of physical agonistic encounters, which is one of the cues used by ethologists to establish dominance relations, diminishes (La Freniere & Charlesworth, 1983; Strayer & Trudel, 1984) while non-physical cues become increasingly relevant (see Hawley, 1999; Roseth, Pellegrini, Bohn, Van Ryzin, & Vance, 2007). For instance, in a 9-month longitudinal study involving 20 preschoolers, La Freniere and Charlesworth (1983) report that among the thousands of social interactions that they observed, only 6.5% could be categorized as physical indicators of dominance, whereas 31% could be categorized as verbal cues of dominance (see also Roseth, Pellegrini, Bohn, Ryzin & Vance, 2007; Strayer & Trudel, 1984).

An important cue of dominance besides physical supremacy is *decision power*: the ability to issue commands that lead to compliance (Trawick-Smith, 1992). Another important cue is age, because a great part of children's first social experiences lies in vertical relations in which older people (parents, siblings) exert control over the children's behavior (Hartup, 1989). Preschoolers are also confronted with slightly older

peers who possess greater cognitive and physical abilities. Finally, according to evolutionary theories of dominance, establishing control over resources is the ultimate goal of dominance hierarchies. The holding of resources should, therefore, reliably correlate with dominance relations. Even in preschoolers, field and experimental research indicate that the ability to control desirable resources is highly correlated with dominance (Charlesworth & La Freniere, 1983; La Freniere & Charlesworth, 1987). Thus, resource asymmetry should be another reliable cue to dominance.

The present study also extends our understanding of dominance related reasoning by studying preschoolers' inferences from dominance relations to dominance features (Experiments 3 and 4).

More specifically, Experiments 3 and 4 investigated whether children use dominance relations to infer various attributes of the dominant and subordinate individuals. In Experiment 3, children identified as dominant the individual who exerted decision power over another and then had to decide which of these two individuals would win in an unrelated game. Experiment 4 tested whether children expect an individual who exerted decision power over another to hold more resources.

EXPERIMENT 1

The goal of Experiment 1 is to investigate preschoolers' ability to detect dominance relations. Children were presented with short scenarios that involved two puppets and were asked to indicate which was "the boss." Experiment 1 tested each of the dominance

cues presented above—physical supremacy, decision power, age, and holding resources—in 4 different scenarios.

Participants

One hundred and twenty-eight children (63 girls) participated in this study with written parental consent. The children attended two kindergartens in the same district of Lyons (France). The results of 18 children were excluded from the analysis. Thirteen children were excluded because they failed to provide an appropriate answer to preliminary comprehension questions (see below). Four children were excluded because they failed to provide answers to one or more of the stories. Finally, one child was excluded due to experimenter error. The final pool was composed of 110 participants in the following three age groups: 20 girls and 19 boys in the 3-years-old group (*range:* 3-3;11, M_{age}: 3;6); 20 girls and 16 boys in the 4-years-old group (*range:* 4-4;11, M_{age}: 4;4); 16 girls and 19 boys in the 5-years-old group (range: 5- 5;11, M_{age}: 5;5).

Materials

Four scenarios were created, each including a different cue to dominance. In all cases, the two puppets were identical (a detailed description of each scenario is provided in the Appendix).

Scenario 1. Physical supremacy : two puppets play fight twice and the same puppet wins the confrontation on both occasions.

Scenario 2. Decision-making power : two puppets verbally express conflicting desires over games that they could play together. The situation occurs twice and the same puppet

successfully imposes its favorite game on both occasions.

Scenario 3. Age asymmetry : two puppets announce their ages. One puppet is one year older and the other puppet is one year younger than the participant. The puppet representing the older child is held slightly higher to appear taller.

Scenario 4. Resource asymmetry : the two puppets present their marble boxes. One has two marbles and the other has a single marble. The child is asked to count the marbles in each box.

Design And Procedure

Each child was presented with the four scenarios in a counterbalanced order following a Latin Square design. Children were taken from the classroom and seated in a separate quiet room in front of a table. The experimenter sat in front of the child and played the four scenarios. The two puppets' spatial position and turns of speech were counterbalanced across trials. After each story, the experimenter asked the question "Who is the boss?" ("C'est qui le chef?") and children provided their answers by pointing to a puppet. In France, the use of "chef," which can be translated as "boss," is very frequent. School children commonly use the phrase "être le chef" (being the boss) in situations of conflict over decisions or resources. Typical sentences include "c'est moi le chef " ("I am the boss"), "Qui a dit que c'était toi le chef?"("who said you were the boss?"), etc. Thus, asking "C'est qui le chef?" (Who is the boss?) should seem perfectly natural for French children. Two comprehension questions were asked to assess the understanding of the word "chef." The first question was: "Who is the boss of your classroom?" If the child named an adult of the school team (teacher, assistant or director), her answer was

assessed as correct. If not, a second question prompted the child to choose between her original answer and the teacher. For example, if the child's first answer was "Me," the second question was "Who's the boss in the classroom, you or the teacher?" If the child still did not name the teacher, we ran the experiment but excluded her results from the analysis.

Statistical Analysis

In order to investigate the relationships between the experimental variables, data were analyzed using log-linear models (Agresti, 2002)**.** Since there is no need to distinguish dependent from independent variables in log-linear models, the method is useful for finding significant associations between any two or more categorical variables. The method consists in identifying the model that best fits the original multi-way frequency table containing all variables of interest. The starting point of each analysis is a saturated model, which perfectly fits the frequency table by modeling all possible associations. For a given number of variables (*n*), the saturated model contains all possible associations up to the *n*-th order. To select the final model, the estimation algorithm eliminates one by one all unnecessary high-order effects on the basis of the Bayesian Information Criterion (Kass & Raftery, 1995). The final model is the simplest model that still contains all the original variables and that is statistically similar to the saturated model. When this final best-fit model still contains associations between two or more variables, then these variables are significantly associated. All statistical computations were done with R (R Core Team, 2011).

Results

The results from the two comprehension questions, including all the original set of 128 children, indicate that, at a very high rate (90%), children identified the teacher or another responsible adult as the boss by answering correctly to the first or the second comprehension question. The first comprehension question was open ended contrary to the second comprehension question which was a forced-choice ("Who's the boss of your class?" versus "Who's the boss of your class: [child's first answer] or the teacher?). Interestingly, the proportion of children who gave a correct answer following the first question significantly increased with age (52% of 3-years-old; 65% of 4-years-old; 82% of 5-years-old; $\chi^2(2, N = 128) = 9.2$, $p = 0.01$). Given that the second comprehension question offers a forced choice between two options, participants who correctly answered this question, after erring on the first one, might have chosen the correct response randomly. To assess whether these participants affect the overall pattern of data, we included the first comprehension question as a variable in the statistical analysis.

Using a log-linear model we examined the relationship between the first comprehension question, the 4 scenarios, age group, participant's gender, and dominance detection into a 5-way cross table. The best resulting model, which included significant 2nd order associations, showed that the type of scenario was significantly associated with dominance detection. In particular, when the rate of dominance detection was analyzed in each scenario (see Table 1), it appeared that the dominant puppet was identified as the boss more often than the subordinate puppet in the physical supremacy scenario (binomial test, p =.001), the decision power scenario ($p < .0001$), and the age scenario (p

< .0001) but not in the resource asymmetry scenario (p = .39). The analysis also showed that as children grow older dominance detection increased. However, as shown by Table 1, this effect seems to result from the low level of dominance identification by the 3-year-old children in the resource asymmetry scenario (36%). Finally, neither performance on the first comprehension question nor gender was significantly associated with dominance detection. Since performance on the comprehension question was not associated with performance on dominance identification, all children who correctly answered either the first or the second comprehension question were included in the following analyses.

Given that the *resource asymmetry* scenario differed from the other three dominance cues and failed to elicit a level of performance that was significantly above chance, we also performed a statistical analysis on the three successful cues. Using a log-linear model we examined the relationship between the scenarios (physical asymmetry, decision power and age), age group, and dominance detection into a 3-way cross table. The best resulting model was one in which no significant 2nd order association remained. This time, neither the type of scenario nor age group was significantly associated with dominance detection. This means that the three scenarios led to similar levels of dominance detection and that the three age groups did not significantly differ in identifying the dominant in these three scenarios. This suggests that the previously reported age effect was mainly due to age group differences in the resource asymmetry scenario.

Finally, we also examined whether the three successful scenarios were associated with each other—whether providing the expected answer in one scenario makes it more likely

that it will be provided in the others. To perform this analysis we used a log-linear model in which each scenario was included as a different dichotomous variable (correct vs. incorrect) into a 3-way cross table. The best resulting model was one in which no significant 2nd order association remained. Hence, the three successful cues – age asymmetry, physical supremacy and decision power – were not significantly associated with each other.

Discussion

Experiment 1 demonstrated that preschoolers were able to identify dominance relations based on three kinds of cues. In line with the results found in infants (Thomsen et al., 2011), children used physical supremacy as a cue to infer which of two puppets was dominant. In addition to physical supremacy, age and the ability to impose one's decisions were successfully taken into account to attribute dominance. This result is in line with the human ethological literature that suggests the great significance of these cues in preschool age hierarchies (La Freniere & Charlesworth, 1983; Montagner, Restoin, Rodriguez, & Kontar, 1988; Williams & Schaller, 1993). It should be noted that these three cues are statistically independent from each other since identifying the dominant on the basis of one cue does not allow predicting that the dominant will be identified on the basis of the other cues. This suggests that children differed with respect to the cues they preferentially used to make a dominance judgment. In addition, these cues gave rise to similar identification rates, which seems to indicate that they were equally accessible to detect who the dominant was. Choosing the dominant when answering the questions in the different scenarios is probably not accounted for by a

general mechanism of saliency or attractiveness of the dominant character. In an unpublished study (Charafeddine et al., in preparation), we obtained data relevant to this issue. One hundred forty three 3- to 6-year-old children answered a resource distribution task after watching a decision making power situation similar to the one used here. The children were distributed in three age groups: 3-year-olds (3-3;10, Mage = 3;6), 4-year-olds (4-4;11, M_{age}= 4;7) and 5-year-olds (5-6, M_{age}= 5;5). After the main task, children answered two successive questions. The first was a dominance detection question: "Who is giving orders?" The second tested children's preference: "Which puppet do you want to play with?" While most participants (92%, $p < .0001$) identified that the dominant was the puppet who imposed his choice, only half of them (48 % , $p = .7$) showed a preference for that puppet. This pattern of results was observed for each of the three age groups, suggesting that dominance detection is independent from a positive evaluation of the dominant.

Finally, although children used physical asymmetry, decision power and age cues to identify dominance relations they did not do so when confronted to resource asymmetry. Given the importance of access to resources in defining dominance, the children's low performance in the resource condition was surprising. This unexpected finding prompted a search for potential methodological issues. A first issue is that marbles might not be the ideal type of resource. Marbles were chosen because of their money-like properties (i.e., they can be lost, won, and accumulated), but some children may not be familiar with marbles or interested in them. After asking several kindergarten teachers about the resources that children often use, it appeared that they are more likely to treat colored

pencils as valuable goods. A second methodological issue concerns the slight difference in resources held by the two puppets. Although the contrast between having one vs. two marbles is clearly visible, it might not be sufficient to allow the inference of a dominance relation. Increasing the difference between the two puppets might more readily lead children to infer a dominance relation. Experiment 2 was designed to address these issues by using two puppets, one owning 6 colored pencils and another only 2.

EXPERIMENT 2

Experiment 2 was designed to investigate the use of differences in resources as a cue to dominance while addressing the methodological issues discussed above. The paradigm involved resources that were more valuable to the children and more unequally allocated. Moreover, we employed a control condition to ensure that the performance of children in this experimental setting could not be accounted for by a low-level attention bias.

Participants

One hundred eighty-two children from a nursery school in Lyons participated in this experiment. Ninety-six children (53 girls) from a kindergarten in Lyons completed the experimental condition and eighty-six children (60 girls) completed the control condition. In the experimental condition, 4 children were excluded because they did not want to answer the test question. The final data set included 92 children who were distributed over the following 3 age intervals: 18 girls and 12 boys in the 3-years-old group *(range:* 3;1- 3;11 years, M_{age}*:* 3;8 years); 19 girls and 15 boys in the 4-years-old group *(range:* 4-4;11 years, M_{age}: 4;5 years); 14 girls and 14 boys in the5-years-old group (*range*: 5-6

years, M_{age}:5;6 years). In the control condition one child was excluded because he did not want to answer. The remaining participants were distributed over the following three age intervals: 11 girls and 5 boys in 3-years-old group (*range*: 3;6 - 3;11 years, M_{age}: 3;8 years); 27 girls and 12 boys in the 4-years-old group (*range*: 4 - 4;11 years, M_{age}: 4;6 years) and 15 girls and 15 boys in the 5-years-old group (*range*: 5;1 - 5;11 years, M_{age}: 5;6 years).

Design

The children who participated in the experimental condition answered a question about the dominance relation between two puppets holding different amounts of resources (a detailed description of script is provided in the Appendix). However, children's choices might be driven by greater attention to the puppet with more resources regardless of dominance attribution. If attention drives participants' answers, it might be expected that the puppet with more resources would be selected for any comparative question. To test this possibility, participants in the control condition were presented with the same puppets (i.e., one with 6 and the other with 2 colored pencils) and answered a comparative question that was not related to dominance or resource holding.

Material And Procedure

Participants were provided with a single scenario that involved two identical puppets. To ensure that the participants would not draw inferences about the puppets' ages from their resources, each puppet told its name and age, which was the same as the child's age. Then, the puppets displayed their respective colored pencil boxes and asked the child to

count the pencils and name their colors. The puppets then stated how many pencils they had, as follows: “I have 2 colored pencils” *vs*. “I have 6 colored pencils.” The positions of the puppets on the left or right and their turns of speech were counterbalanced across participants.

In this experimental condition, participants answered a slightly different test question from that used in Experiment 1. Given that the resource cue failed to reliably denote dominance in the previous experiment, we needed to assess whether children spontaneously consider that resource asymmetry defines dominance relations before presenting a forced choice test question. Children were thus invited to answer the following preliminary open question: “Do you think that one of the puppets is the boss?” If the answer was “yes,” the experimenter then turned to a more specific question, which was the same as that presented in Experiment 1, that is, “Who is the boss?” If the initial answer was “no,” the second question was phrased in the following manner: “If you had to choose, who among the two would be the boss?” Children in the control condition observed the same scenario and answered the following forced-choice question: “I heard that one of the puppets is very very thirsty and the other one is not very thirsty. Who do you think is more thirsty than the other?”

Results

In the experimental condition, only 14 children (16%) answered “no” to the first question (“Do you think that one of the puppets is the boss?”), a proportion that is below chance level (two-tailed binomial test, $p < .0001$). Ten of these participants answered the

modified test question ("If you had to choose, who among the two would be the boss?") by choosing one of the two puppets (7 designated the wealthier puppet, 3 the poorest puppet). The 4 children who said that none of the puppets was the boss when answering the modified test question were excluded from the analysis.

Table 2 shows the percentages of participants who selected the wealthier puppet in both conditions. In the Experimental condition, 77% of the participants nominated the puppet with the most resources as being the dominant. This proportion significantly differed from chance (binomial test, $p < .0001$). In the control condition, about half of the participants (52%) indicated that the puppet with more colored pencils was thirstier (binomial test, $p = .8$). The wealthier puppet was more often selected in the experimental condition than in the control condition (χ^2 (1, N = 177) = 12.53, $p = .0003$). A log-linear analysis was used to investigate whether age group, gender and condition were significantly associated with children's choice. This analysis revealed a significant 3rd order association between gender, condition and response. In the experimental condition, boys were more likely to designate the wealthier puppet as the boss than girls (see Table 2). In the control condition, boys and girls were equally likely to choose the wealthier puppet. Finally, age was not significantly associated with participant's choice.

Discussion

Experiment 2 showed that most preschoolers were able to infer dominance relations from a difference in the amount of valuable resources held. This was revealed by two facts. First, most of them agreed that one puppet could be said to be the dominant, and second,

they most identified the wealthier puppet as being the dominant one. It is thus likely that the failure of the participants in Experiment 1 to draw this inference was due to methodological issues. Importantly, the control condition showed that the results cannot be explained in terms of an attention bias towards the richer puppet.

Taken together, Experiments 1 and 2 demonstrate that preschoolers are able to use several cues to infer dominance relations: physical supremacy, decision power, age, and resources. An age affect was indirectly associated to the resource scenario in Experiment 1 but not to the improved version of the scenario in Experiment 2. It should be noted, however, that participants from the 3-years-old group in Experiment 2 were slightly older. The interpretation of the unexpected gender effect found in Experiment 2 is unclear and will require further experiments to clarify whether boys and girls really hold different expectations concerning dominance and resource asymmetry.

Experiments 1 and 2 bore on inferences from dominance cues to dominance relations, but an equally rich set of inferences can be drawn from dominance relations to more general comparative judgments. These dominance-based inferences are investigated in Experiments 3 and 4.

EXPERIMENT 3

In Experiment 3, preschoolers were asked to draw an inference from a dominance relation to the competence exhibited in a game. Participants were introduced to two characters that were in a reciprocal bodily positioning of expansion (erect posture) and

constriction (head down posture), which are easily identified by adults as valid cues for dominance and submissiveness (Tiedens & Fragale, 2003) (see Figure 1). Faced with these characters' body postures, children were asked to identify which character gives orders and which complies. As in Experiment 1, this is an instance of a decision power situation. Then, children were asked to identify which of these two characters would win a subsequent game. Although it is plausible that dominant individuals may have at least a small edge in a variety of tasks, it is not obvious that young children will be able to draw such an inference.

Participants

One hundred and eleven children participated in this experiment. One child was excluded due to experimenter error. The final data set included 110 children distributed over the following 3 age groups: 20 girls and 18 boys in the 3-years-old group (*range*: 3-3;11 years; M_{age}: 3;7 years); 17 girls and 20 boys in the 4-years-old group (*range*: 4- 4;11, M_{age}: 4;6 years); 19 girls and 16 boys in the 5-years-old group (*range*: 5-5;11 years, M_{age} = 5;6 years).

Materials And Procedure

Each child was taken from the classroom and seated in a separate quiet room in front of the experimenter. The experimenter showed a picture (see Figure 1) of two characters whose body postures displayed a dominance-subordination relation and narrated that one of two characters was saying "You have to do everything I say! Do what I want!" and the other character was replying "Ok! I will do what you want" (see Figure 1). The

participants were then asked two identification questions about who said what in a counterbalanced order: “Who is saying 'do what I want?' Who is saying 'OK! I will do what you want?'”

The experimenter then introduced the game context and asked children to answer the following test questions presented in a counterbalanced order: “Who do you think will win the game and will be first?” and “Who do you think will lose the game and will be last?”

Note that the nature of the game was not specified to avoid highlighting a specific type of competence.

Results

First, participants strongly associated a verbal order with a specific body posture when answering the identification question: 105 out 110 children (95%) indicated that the erect character was the one who said “Do what I want,” and that the head down character was the one who said “Ok! I will do what you want” (two-tailed binomial test, $p < .0001$). Second, as shown in Table 3, in the three age groups there were significantly more participants who indicated that the dominant character (i.e. the erect body character) would be the winner. Overall, 87 of the children (79%) expected the dominant individual to subsequently win the game, which was significantly greater than chance (two-tailed binomial test, $p < .0001$). All participants consistently answered the two test questions:

when they indicated that one character would win the game, they also indicated that the other character would lose the game.

Using a log-linear model we examined the relationship between the response to the identification question, the response to the test question, age group, and gender in a 4-way cross table. This analysis revealed a significant association between the response to the identification question and the response to the test question. While a large majority of the participants who correctly identified the dominant character on the picture also designated the dominant in the test question (86 out of the 105 children; 82%) only two 2 of the 5 children who failed to answer the identification question designated the dominant on the test question. No other significant associations remained in the model showing that neither gender nor age group was associated to participants' responses.

Discussion

The results of Experiment 3 indicate that preschoolers expect dominants to be more likely to win games than subordinates. They thus tend to turn a dominance relation into a more general skill advantage. However, it is worth noting that the dominance situation presented at the beginning of the task shares some similarities with a competitive game situation, as both involve some form of conflict. In a competitive game, the two protagonists want to win against the other, and in a dominance situation, one can arguably anticipate that both protagonists would prefer to have power over the other. Hence, linking dominance and game competition may be facilitated by the same individual being likely to impose his will in both situations. The next experiment aims to examine whether

participants draw inferences from dominance when the difference in personal attributes does not involve conflict, in this case, holding different amounts of resources.

EXPERIMENT 4

Experiment 4 aims at testing preschoolers' ability to infer a difference in the amounts of resources held by two characters from an identified dominance relation. As in Experiment 3, two characters were introduced, one clearly identifiable as dominant and the other as subordinate based on their bodily postures. Children were then asked to identify which of the two characters held more resources. The distributive aspect of this question carried a risk of introducing a confounding element. Indeed, the dominance situation of verbal command might lead children to hold positive or negative attitudes towards the characters. They may thus be tempted to use resource distribution as a means to reward or punish the perceived moral valence of protagonists' as argued by Kenward and Dahl (2011). To avoid transforming the task into a distributive justice task, methodological precautions were taken to induce children to believe that there was a *right answer* to the test question.

Participants

Seventy-nine children (49 girls) participated in this experiment. They were distributed over the following three age intervals: 9 girls and 3 boys in the 3-years-old group (*range*: 3;6-3;11 years, M_{age}: 3;9 years); 22 girls and 11 boys in the 4-years-old group (*range*: 4-4;11 years; M_{age}: 4;6 years) and 18 girls and 16 boys in the 5-years-old category (*range*: 5-6 years, M_{age}: 5;6 years).

Material And Procedure

Each child was taken from the classroom and seated in a separate quiet room in front of the experimenter. This experiment included a training story and a test story. In the training story, participants observed two characters holding different amounts of resources and they indicated who had more resources. In the test story, participants were presented with a dominant and a subordinate character and they had to guess who had more resources. The purpose of the training story was to indicate that the task was not that of a resource distribution in which they had to reward or punish the characters by allocating them resources. Moreover, the instructions made clear that the participant should provide an answer that she expected to be true and not an answer reflecting a preference for one or the other character. The instructions given by the experimenter were as follows: “I'm going to show you two stories. In each story, there are two images. I will show you both images of the first story, which means that you will see the full story. But, in the second story, I will only show you the first image. You will have to think hard and guess what's in the second image. I can see the second image myself, so I can check afterward whether you guessed it right.”

In the training story, children were shown a picture with two characters, an orange and a red one, followed by a second picture that depicted the two characters with different amounts of resources (see Figure 2). For half of the participants, the resources were cookies. For the other half of the participants, the resources were pencils. All children correctly perceived who had more cookies or pencils in the training story. They were then

presented with the test story, which included the same dominance picture and the same dialogue as in Experiment 3 and were first asked the same identification questions. Then, the experimenter presented the following two test questions, which referred to the same resources as those presented in the training story, in a counterbalanced order: “Who do you think has more cookies [/pencils]?” And “Who do you think has fewer cookies [/pencils]?”

In the training story, the position (up or down) of the character with more resources was counterbalanced across participants. In the test story, the position of the dominant (left or right) and the order of questions were counterbalanced. Finally, children were asked to provide justifications for their answers.

Results

The results concerning the association between verbal order and body posture were in line with those of Experiment 3. Seventy-six out of 79 children (96%) indicated that the erect character was the one who said “Do what I want,” and that the head down character was the one who said “Ok! I will do what you want”(exact two-tailed binomial test, $p <$ .0001). Second, as shown in Table 4, in the three age groups there were significantly more participants who indicated the dominant character (i.e. the erect body character) as owning more resources. Overall, 65 children (82%) expected the dominant character to own more resources, which was significantly greater than chance (two-tailed binomial test, $p <$.0001). All participants consistently answered the two test questions: when they

indicated that one character had more resources, they also indicated that the other character had fewer resources.

Using a log-linear model we examined the relationship between the response to the identification question, the response to the test question, age group, and gender in a 4-way cross table. The best resulting model was one in which no significant 2nd order association remained. Hence, the response to the test question was not significantly associated with any of the other variables.

We now turn to the justifications. Answers were coded by 2 research assistants. Inter-rater agreement reached 96% (Kappa, $p < .0001$). Fifty-two percent of the participants produced verbal reports that could be clearly identified as justifications. They were classified into four main categories:

- Dominance related responses. Children explicitly referred to what the characters said to each other, or to their respective status: “because this one gives orders,” “he says do as I want,” “he is the boss” or “he is not the boss.”
- Comparative responses. Children mentioned an asymmetry between the two characters which might be relevant to dominance but which does not explicitly refer to it: “this one looks bigger,” “it seems like this one is the big brother,” “he eats more.”
- Resource-related responses. Children referred to the resources and often seemed to indicate that the two characters were competing for them: “he took all the cookies,” “he said I want more and the other said help yourself,” “he took a lot of cookies and he only took few,” “because this one wins.”

- Image-related justifications. Children referred to morphological or postural differences between the characters on the picture: “he doesn’t seem happy,” “he’s pointing his finger,” “he has a bigger belly.”
- Other psychological attributes. Children referred to characters’ tastes or states of mind: “they love chocolates,” “he seems so shy,” “he doesn't eat.”

The percentages within each category are presented in Table 5. Unjustified answers (38%) are not presented in this table; they included cases of no response, self-evident statements (“because”,“I don’t know,” etc.) or irrelevant answers (“I know everything”).

Discussion

The ability to infer asymmetry in resources from a dominance situation is robust by 3 years of age. This finding is consistent with classic distributive justice experiments (Damon, 1980) in which preschool-aged children justify inequalities in resources by appealing to dominance-relevant personal characteristics such as higher age. This result also suggests that children’s conception of dominance is well tailored to the social environment, as, from toddlerhood onward, dominant children are the most successful in obtaining resources (La Freniere & Charlesworth, 1987; Plusquellec, François, Boivin, Perusse, & Tremblay, 2007). Interestingly, the inference captured in this experiment is relatively subtle, and it leads to generalizations. The initial situation describes an interaction in which one individual imposes his will on another. The final situation, which involves a basic social comparison, does not refer to power or coercion. Hence, the data shows that participants link two important but different dimensions of dominance.

Finally, the justifications can provide some insight into how children made this link. For children who produced explicit dominance-related justifications (i.e. the modal answer), the link could be quite direct: the higher status of the dominant or the fact that he is giving orders might be sufficient to consider that he has more resources, no matter how these resources were obtained. Yet, for other children, as those who explicitly refer to resources, more complex interpretations are plausible: they may have assumed that both characters had competed for resources ("he took a lot of cookies [dominant] and he [subordinate] only took few") or that the subordinate had asked the resources of the dominant ("he [subordinate] said 'I want more' and the other [dominant] said 'help yourself'"). Other children might also consider that the character that gives orders is more competent and is thus better at getting resources. Of course caution is required when interpreting justifications, but at least they suggest that different types of reasoning may lead children to associate resources with dominance. Future research is needed to explore further the cognitive pathways used to make this link.

GENERAL DISCUSSION

Dominance is one of most enduring social properties of our past environment and might have favored the emergence of specific cognitive adaptations or, at least, a strong sensitivity to the interactions of subordination and domination. In spite of ethological studies showing that hierarchical relationships play an important role in preschoolers' social environment, few experimental studies have systematically addressed the way preschoolers represent dominance. The present experiments demonstrate that

preschoolers are able to accurately draw a variety of dominance-related inferences and they do so by answering explicit questions about the characters' status ("Who is the boss?" "Who is saying 'Do as I want?'") or their attributes ("Who will win the games?" "Who has more pencils?").

The present results show that the representation of dominance is based on a rich and diverse set of cues. When observing two individuals interacting in antagonistic ways, preschoolers made dominance judgments not only based on physical superiority but also on verbal interactions (Experiment 1). This fits well with the evidence that dominance relationships among preschoolers are primarily verbally expressed and consist in influencing others' actions in games and group activities (Williams & Schaller, 1993). In addition, the results from the preliminary identification questions in Experiments 3 and 4 indicate that preschoolers easily associate verbal orders with cues of body posture. Preschoolers are also able to rely on cues that do not involve verbal or physical conflict. They can infer that an older child or a child with more resources is more likely to be dominant (Experiments 1 and 2). Again, these results are in line with ethological studies showing that the level of access to desirable resources among preschoolers is highly correlated with their dominance (La Freniere & Charlesworth, 1987). The present findings also show that preschoolers draw inferences not only to dominance relations, but also from dominance relations. In Experiment 3, children inferred that a dominant individual would win a game against a subordinate. Experiment 4 showed that children infer that a dominant individual is likely to have the most valuable resources.

In the interpretation of the results, we assumed that children relied on mechanisms specific to dominance and did not simply follow a general trait-consistency heuristics, which would consist in matching any positive properties together (for instance "being the boss" with "having more resources"). This would be a more specific version of the halo effect (Nisbett & Wilson, 1977), which shows that positive evaluation of people on one dimension (e.g., physical attraction) elicits a positive evaluation on unrelated dimensions (e.g., personality traits). Our results speak against this interpretation.

The log-linear analysis of Experiment 1's data revealed that the three cues used to infer the dominant were independent. If identifying the dominant amounted to matching positive properties together, we should expect some children—those who rely on this mechanism—to do it more consistently than others. Instead, different children seem more or less likely to take each dominance cue into account, suggesting that they rely on mechanisms specific to each cue rather than a more general mechanism. Moreover, if children's choice resulted from a halo effect, they should also display a preference for the dominant, since he has not only this positive trait, but others as well, such as having more resources. As detailed in the discussion of Experiment 1, we did not find evidence for such preference in an another still unpublished experiment (Charafeddine et al., in preparation).

Although the present findings show that young children have a good ability to understand dominance relations, it should not be concluded that this ability is immune to various influences. Early studies have shown that preschoolers tend to overestimate their

own dominance status as well as that of liked peers (Boulton & Smith, 1990; Edelman & Omark, 1973; Omark & Edelman, 1975; Omark, Omark, & Edelman, 1975; Sluckin & Smith, 1977; Strayer et al., 1978). How these different factors interact should be the topic of further investigation.

Until recently, the most important cognitive ability thought to be required for coping with the complexities of social world was mindreading, that is, the capacity to explain others' behaviors in terms of mental states such as knowledge, desires and beliefs (Hobson, 2002; Wellman et al., 2001). However, another line of research has succeeded in extending social cognition from the processing of other individuals' minds to the interactions of individuals within and across social groups. Within the folk sociology framework developed by Jackendoff (1995) and (Hirschfeld, 1995), some developmental psychologists have undertaken the description of cognitive strategies that allow children to process group membership (Kinzler, Shutts, & Correll, 2010; Rhodes, 2013), deontic reasoning (Clément, Bernard, & Kaufmann, 2011) and social alliances (Pietraszewski & German, 2013; Rhodes & Chalik, 2013). In line with this approach, the present study contributes to the understanding of the cognitive mechanisms underlying the representation of asymmetrical social relations.

Given the importance of dominance relations throughout human social life, including the social life of very young children, it is not surprising that preschoolers are able to use a variety of cues to infer dominance relations and that they use information about these relations to make further inferences about their social environment. What is surprising is

how little attention has been paid to these mechanisms in experimental developmental psychology. This study is a new step in understanding this rich tapestry of inference.

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APPENDIX

Experiments 1 And 2 Scripts

Physical supremacy

A-Hello, my name is Raph. I am very strong and I like so much to play fight.

B-Hello, my name is Thomas. I am also very strong and I, too, like so much to play fight.

-Both: Yes! We can play fights together! 1,2,3...

Fighting lasts for approximately one minute and ends with one puppet held on the ground by the other.

-Both: Wow! It's so tough to play fights but it's so amusing. Let's do it one more time!

1,2,3...

Another fighting episode is shown. It is similar to the first one, with the same winner.

-Both: It's so fun to play fights but it's so tough!

Decision Power

A (subordinate): Hi Nico!

B (dominant): Hi Léo! What are you playing?

A: I'm playing with marbles. Do you want to play marbles with me?

B: Oh no! I don't want to play marbles. I want so much to play ball. Come, we should play ball.

A: No, but I like to play marbles. Let's play marbles!

B: No, let's play ball, it's so much fun! Come on!

A: Ok! I'm coming!

They play with an imaginary ball.

B: You see, it's so fun to play ball.

A: Yeah, it's so fun.

B: Ok let's play something else now. Let's jump.

A: No, let's rather run, it's so fun.

B: No, let's jump, it's much more fun. Come on!

A: Ok! I'm coming.

They jump together

B: See? It's fun to jump!

A: Yeah, it's fun!

Age asymmetry

During the sketch, both puppets address the participant.

A: Hello, my name is Julien.

B: Hello, my name is Yann.

A: I am [1 year older than the participant] years old. Show me how much [AGE] is with your fingers. (*counts*). Yeah, that's right!

B: I am [1 year younger than the participant] years old. Show me how much [AGE] is with your fingers. (*counts*). Yeah, that's right!

Resource Asymmetry (Experiment 1)

A: Hello, my name is Polo.

B: Hello, my name is Théo.

A: Hi Théo!

B: Hi Polo!

Together: We are going to play with marbles.

A: I will go bring my marble box. Where are you, my marble box? Oh, here it is. This is my OWN marble box.

B: I will bring my marble box as well. Where are you, my marble box? Oh, here it is. This is my OWN marble box.

A: Look (*to the child*)! How many marbles do I have? Oh one? Is it nice? OK.

B: Look! How many marbles do I have? Oh two? Are they nice? OK.

Ressource Asymmetry (Experiment 2)

A: Hi, I'm [Age of the Child] years old.

B: Hi, me too, I'm [Age of the Child] years old.

A & B: We have something that we want to show you; do you want to see?

Those are our colored pencil boxes.

A: This is my colored pencil box

B: And this is mine! It's my pencil box.

A: How many pencils do I have? What color are they?

B: How many pencils do I have? What color are they?

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Table 1 Percentages of Children in the Three Age Groups Choosing the Dominant Puppet in Experiment 1

	Dominance cue							
	Physical supremacy		Decision making power		Age asymmetry		Resource asymmetry	
Age Group	%	*p*	%	*p*	%	*p*	%	*p*
3-years-old (N = 39)	59	.3	69	.02	72	.009	36	.1
4-years-old (N = 36)	67	.06	69	.03	78	.001	67	.06
5-years-old (N = 35)	71	.02	83	.0001	86	.0001	63	.17
Total (N=110)	65	.001	74	< .0001	78	.0001	55	.3

Table 2 Percentages of Participants in the Three Age Groups Choosing the Wealthier Puppet in Experiment 2

			Condition				
		Experimental			Control		
Age Group	Gender	N	%	*p*	N	%	*p*
3-years-old	Girls	18	55		11	36	
	Boys	12	92		5	60	
	Total	30	70	.04	16	44	.80
4-years-old	Girls	19	68		27	52	
	Boys	15	80		12	58	
	Total	34	73	.009	39	54	.75
5-years-old	Girls	14	86		15	60	
	Boys	14	93		15	46	
	Total	28	89	<.0001	30	53	.85
Total		92	77	<.0001	85	52	.83

Table 3 Percentages of Participants in the 3 Age Groups by choice type in Experiment 3

Age Group	Answer		*p*
	Dominant	Subordinate	
3-years-old (N = 38)	76 %	24 %	.002
4-years-old (N = 37)	76 %	24 %	.002
5-years-old (N = 35)	86 %	14 %	< .0001
Total (N=110)	21 %	79 %	< .0001

Table 4 Percentages of Participants in the Three Age Groups Choosing the Dominant or the Subordinate in Experiment 4

Age Group	Answer		*p*
	Dominant	Subordinate	
3-years-old (N = 12)	83 %	17 %	.04
4-years-old (N = 33)	82 %	18 %	.0003
5-years-old (N = 34)	82 %	18 %	.0002
Total (N = 79)	82 %	18 %	< .0001

Table 5 Percentages of Each Justification Type by Answer

	Answer	Total	
Justification Type	Dominant (N=41)	Subordinate (N=7)	
Dominance Related	36 %	0	30%
Comparative	13 %	0	11%
Resources related	23 %	57 %	28 %
Image related	28 %	18 %	19 %
Other Psychological Attributes	14 %	10 %	11 %

Figure 1.

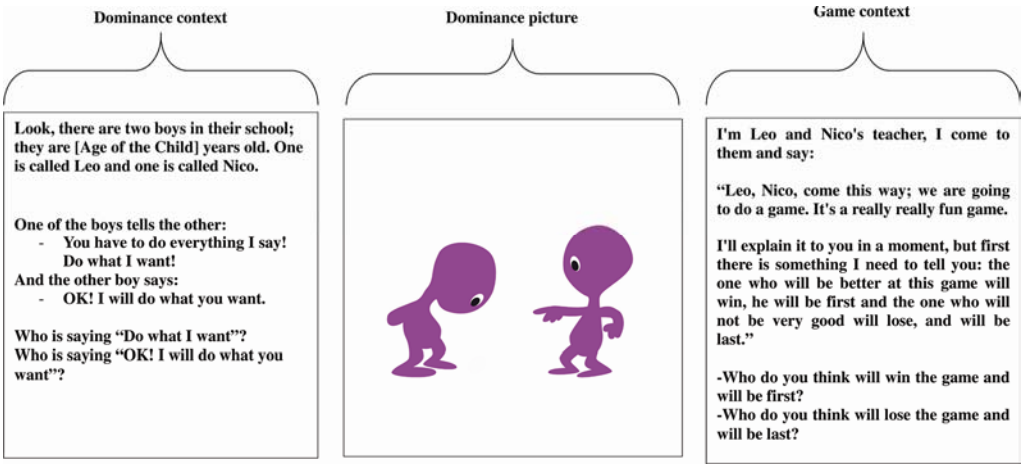

Figure 2.