Children’s capacity to use cultural focal points in coordination problems

Efrat Goldvicht-Bacon, Gil Diesendruck

Department of Psychology and Gonda Brain Research Center, Bar-Ilan University, Israel

Abstract

Coordination problems require one to act based on expectations about how partners will act. In Experiment 1, 5-year-olds (n = 57) had to hide a sticker in the box another child from their, or a different, culture was most likely to search in. Boxes were marked with cues presumed to be known by everybody, cultural members, or the child. Experiment 2 assessed 5-year-olds’ (n = 57) behavior in a competition scenario. In Experiment 1, children were more likely to hide in the cultural box when playing with a same-than a different-culture partner. In Experiment 2, children’s behavior was the opposite. Thus by age 5, children are capable of modulating their actions in coordination problems, according to their partners' presumed knowledge.

Keywords: Coordination problem, Focal points, Common knowledge, Children, Cultural group membership, Cooperation/competition

1. Introduction

Imagine that you have set up to meet a friend from a distant city, whom you have not seen in a long time. The night before the date, you two decided to coordinate the time and place of the meeting over mobile phone on the next morning. However, in the morning, you realize that you left home without your phone. What do you do now? If you have to decide on a time and place where the two of you would think of as a meeting place, without coordinating in advance, where and when would it be? In his book, The Strategy of Conflict, Schelling (1960) presented his subjects with a similar dilemma. The subjects, mainly New York natives, often converged on the same time – 12 noon – and the same place – Grand Central Station. How did these subjects manage to choose the same time and place despite having no prior coordination? Situations like this happen frequently in our daily life: a phone conversation gets cut-off, how do you coordinate who will call and who will wait for the call-back? Two drivers want to switch lanes at the same time, who waits and who passes first? What is needed in all these cases is a coordination of knowledge states, and consequent expectations about people’s behaviors. More specifically, Person A reasons that he knows X, that Person B also knows X, that Person B knows that Person A knows X, and so on, until both Person A and B reach a decision threshold that allows them to derive a reasonable expectation about how to act (Kyle, DeScioli, Haque, & Pinker, 2014). According to Schelling, one shortcut for this infinite string of inferences is the capacity to read the same cue in a common situation, and the identification of that cue as a point onto which the expectations of A and B may coalesce – what Schelling called “focal points”.

As noted by Schelling and others (e.g., Barr, 2004; Mehta, Starmer, & Sugden, 1994; Sugden & Zamarron, 2006), adults are fairly adept at finding such focal points. And they are so because they are quite competent at inferring what is conventional shared knowledge amongst members of a community, and can thus generate reasonable expectations about how others might act based on this knowledge (Clark, 1996; Lewis, 1969). Crucially, in their grounding on common knowledge, focal points are by definition culturally and contextually sensitive. For instance, the results of Schelling experiment would likely have been different had the subjects been Parisians, and had the friends set up to meet at night. Perhaps certain types of knowledge are universally shared (e.g., house number 1 is the first on a street), but others are cultural (e.g., Grand Central Station), and yet others are idiosyncratic (e.g., one’s favorite restaurant). Thus, in coordinating an action with another person, we adjust our expectations based on the knowledge we assume to share with a specific partner. In other words, to succeed in such coordination problems, one needs to be capable
of: (a) estimating what his/her partner knows, and (b) adjusting this estimation based on what is supposed to be known, and who the partner is. The present studies investigate whether young children have these capacities.

A number of studies reveal that indeed even infants have some capacity to estimate others’ knowledge. For instance, Moll and colleagues showed that 14-month-olds reacted correctly to an ambiguous request by an experimenter (“can you get me that?”), by choosing the specific object that they had shared previously with that experimenter (Moll, Richter, Carpenter, & Tomasello, 2008; see also Saylor & Ganea, 2007). With increasing age, toddlers can even succeed in distinguishing the specific knowledge they share with different partners. For instance, 2-year-olds inferred that if a speaker asked them for the referent of a novel name, the referent was likely to be the one object that speaker had not previously seen. Children chose randomly, however, if the speaker had seen all the objects in display (Diesendruck, Markson, Akhtar, & Reudor, 2004; see also, Liebal, Carpenter, & Tomasello, 2010). By preschool age, children start modulating their expectations about what others know, based on the common knowledge established in a given context. Thus, 3-year-olds succeed in maintaining different pretend identities of objects established with different pretend partners (Wyma, Rakoczy, & Tomasello, 2009), and expect another agent to act in accordance with a novel game rule they had both been exposed to, and do not extend this expectation to an agent who had not been part of the pact (see Rakoczy & Schmidt, 2013, for a review). Moreover, 3-year-olds, and even more so 5-year-olds, are sensitive to the partner-specific nature of “referential pacts” – e.g., the establishment of particular names to refer to potentially ambiguous objects – thus evincing some difficulty in interpreting a request when a partner in the pact violates it (Matthews, Lieven, & Tomasello, 2010; see also, Koymen, Schmerse, Lieven, & Tomasello, 2014).

Importantly, in all these cases, children were required to respond to a partner’s communicative act, by assessing the partner’s knowledge of the relevant information in a given communicative context. Coordination problems are more taxing, because they require children to initiate an action based on presuppositions about their partner’s knowledge of the relevant information in any given situation, and the consequent expectations about how the partner will act in that same situation. There is some evidence that with minimal communication – i.e., eye contact – 4-and-a-half-year-olds succeed in coordinating actions with another partner (Wyman, Rakoczy, & Tomasello, 2013). However, to our knowledge, only one study to date has directly addressed children’s capacity to coordinate actions in the absence of communication with a partner. In their recent study, Grueneisen, Wyma, and Tomasello (2015) tested 3- to 8-year-olds in a task that required children to choose in which box to hide an object, such that if another child chose to hide his object in the same box, the subject would win a prize. Three of the boxes had the same picture affixed to them, whereas a fourth box had a distinct picture. Grueneisen et al. found that starting at 5-years of age, children succeeded in picking the distinctive box as a preferred location to hide the object. In other words, children at this age succeeded in converging on the focal point in that given situation.

The question the current studies address is whether children are capable of modulating their actions in coordination problems, according to the type of knowledge presumed to be known and who the partner is. In other words, in addition to asking whether children can rely on a seemingly universal cue to what the focal point in a given situation is (e.g., a salient mark, as in Grueneisen et al., 2015), can children recognize that certain cues will be viewed by some partners as focal points (e.g., cultural cues by cultural members), and others might seem focal only to themselves (e.g., idiosyncratic cues)?

Plenty of research demonstrates that by age 5, children make generalizations based on people’s social group membership, and expect members of the same social group to share a number of psychological characteristics (Diesendruck & HaLevi, 2006; Dunham, Baron, & Carey, 2011; Shutts, Roben, & Spelke, 2013). More sparingly, however, there are only a few studies suggesting that children at this age have different expectations about what others know based on their group membership. For instance, 4-year-olds expect speakers of their language – but not of a different language – to know the common names of objects, and they do not expect even speakers of their language to know the proper names of novel creatures that only they had been exposed to (Diesendruck, 2005). Moreover, at this age, children also start assuming that familiar objects and certain social conventions are cultural common ground, and thus presumed to be known by members of their cultural community (Liebal, Carpenter, & Tomasello, 2013; Schmidt, Rakoczy, & Tomasello, 2012).

Whether these conceptual achievements suffice for children to coordinate actions based on differential expectations about what knowledge is shared by whom, is a question motivating the present studies.

Similar to Grueneisen et al. (2015), we too presented 5-year-olds with coordination problems in which they had to decide in which one of a number of boxes they should hide an object. Differently from Grueneisen et al., however, we manipulated two crucial variables. First, we marked one box in each set with a cue that was supposed to be known only by the participant (e.g., his/her name was written inside the box), another with a cue that was supposed to be known by members of the participant’s cultural group (e.g., the Israeli flag), and a third with a cue that was supposed to be known universally (e.g., a picture with all the world’s flags). Second, in half of the trials children played the “hiding game” with a partner from their cultural group (i.e., an English-speaker from England). A further addition to the present experiments is that we used two rather distinct types of cues, namely, verbal and visual ones. This was done primarily to provide a broad assessment of the processes presumably underlying children’s decisions.

In Experiment 1, the goal of the game was described to the child as cooperative. Namely, the child was asked to hide a sticker in one of the boxes, such that if the partner eventually chose to look for the sticker in the box the child had chosen, the child would win the sticker. In other words, the child had to guess in which of the boxes the partner was most likely to search, and then place the sticker there. From a logical standpoint, two cues are supposed to be known by a same-culture partner – i.e., the cultural and the universal cues – but only one by a different-culture partner – i.e., the universal cue. Consequently, when playing with a different-culture partner, children’s choice should be straightforward: hide the sticker in the box marked with the universal cue. However, when playing with a same-culture partner, children face a dilemma between two logically equivalent options.

Given these considerations, our “cautious” hypothesis was that if children are capable of modulating their decisions based on expectations about what different others know, then they should be more likely to select a box marked with a cultural cue when playing with a partner from their culture (since that partner might recognize that cue), than when playing with a partner from a different culture (since that partner is much less likely to recognize that cue). A “stronger” hypothesis is that when playing with a same-culture partner and thus facing the dilemma between the two logically equivalent options, children will select the option that is most relevant to that particular partner (Spelke & Wilson, 1986); namely, select the cue that is most distinctive. In this case, the stronger hypothesis is that when playing with a
partner from the same culture, children should choose the cultural cue more often than the universal cue.

In Experiment 2, we assessed the robustness of this capacity by extending the investigation to a somewhat more complicated case of coordination. The study had the same design as Experiment 1, only now children were told that the goal of the game was competition. Namely, the child was asked to hide the sticker in one of the boxes, such that if the partner chose to look for the sticker in the box the child had chosen, the child would lose the sticker. In other words, the child had to guess in which of the boxes the partner was most likely to search, and then not place the sticker there. The main hypotheses here were the reverse of those phrased for Experiment 1. Namely, in Experiment 2, (a) children should be more likely to select a box marked with a cultural cue when playing with a partner from a different culture, than when playing with a partner from the same culture, and (b) when playing with a partner from a different culture, children should choose the cultural cue more often than the universal cue.

2. Experiment 1

2.1. Method

2.1.1. Subjects

Fifty-seven Jewish Israeli children (31 boys, 26 girls) from two kindergartens in the greater Jerusalem area participated in the experiment ($M_{age} = 68.14$ months, $SD = 6.09$, range = 56–83 months). Due to lack of cooperation, data from three additional subjects were not taken into account in the final analyses. Only children with signed parental permission participated.

2.1.2. Design

The study was entirely within-subjects, with two factors manipulated: partner's culture (same or different from the subject), and type of cue provided (individual, cultural, or universal). The procedure consisted of four trials, two played with a same-culture partner, and two with a different-culture partner. All types of cues were presented in all four trials, via marks attached to boxes. The goal of the child in all trials was to choose the box the partner was most likely to choose as well, so as to earn prize-stickers.

2.1.3. Materials

The partner’s culture was operationalized via short videos (approximately 7 s), in which a boy or a girl (gender and age matching the subject) appeared, and was presented as a partner in an internet game. Two of the “actors” said a few sentences in English (e.g., “Hi, my name is Michael. How are you? Do you want to play with me?”), and were described as being from England, thus representing partners from a different culture than the subject's. The other two said the same sentences in Hebrew, and were described as being from Israel, thus representing partners from the same cultural group as the subject.

Type of cue was manipulated via various marks attached to different sets of boxes. In order to sample a variety of possible cues, in two of the four trials children were shown verbal marks attached to three boxes, and in the other two trials children were shown visual marks attached to four boxes. One trial of each kind was associated with a same- and a different-culture partner.

In the verbal trials, words written in Hebrew were attached to each of three boxes, instantiating the different types of cues. The individual box had the words “don’t know” attached to it. Its individuality was established by the fact that the experimenter revealed “a secret” to the child, namely, that the child’s name was written inside the box. The cultural box had the word “sticker” (i.e., the prize) written on it. Its cultural-specificity was thus established by the fact that only a Hebrew-speaker would be able to understand that cue. The universal box had the word “maybe” written on it. Its universality consisted of the fact that it was always displayed in the central position of the three-boxes set. Schelling (1960) noted that focal points are intrinsically more prominent because they are unique, i.e., they avoid ambiguousness. Thus, the center of a plane or the middle-position, are unique, because they avoid the ambiguity of choosing a side. In fact, a recent study documented that “centeredness” served as a geometric cue used by adults to choose focal points (Chen, Saparov, Pang, & Funkhouser, 2012). Moreover, a pilot study conducted with 15 5-year-olds (9 boys; $M_{age} = 61.20$, $SD = 4.26$), confirmed this expectation. These children were given the same cooperative task as the children in Experiment 1, except there were no labels on the boxes, and their partner was always defined as being from their culture. We found that 12 of the children (80%) hid the sticker in the central box, $\chi^2(1, N = 15) = 5.40$, $p < .05$.

In the visual trials, each of four boxes had different flags attached to them (see Fig. 1). The individual box had the flag of Canada attached to it. Its individuality again was established by the experimenter revealing “a secret” to the child, namely, that a sticker in the child’s favorite color (previously verified) was affixed to the inside of the box. The cultural box had the flag of Israel attached to it. Its cultural-specificity was thus established by the fact that an Israeli partner would be most likely to recognize it. The universal box had multiple flags attached to it, a fact made salient by the experimenter telling the child, “look there are lots of flags here, from many countries of the world: Israel, the USA, England, China, etc.” We also included a neutral box, which had a flag from another unfamiliar country (Central African Republic) attached to it, and nothing was revealed to the child about it. This cue served mostly as a distractor.

2.1.4. Procedure

Each child was individually tested by the experimenter in a quiet room in their kindergarten. The experimenter sat facing the child next to a table, where a laptop computer was placed and the boxes presented. After a brief introduction in which the experimenter told children that they would be playing a game with prizes, children were asked to pick three stickers that they liked the most. Children were then shown the boxes and were told that only if they won the game they would get these stickers. After this, the objective of the game was explained.

The experimenter told children that they would be playing an internet-game with a child from another kindergarten, who would

![Fig. 1. Illustration of the visual trial.](image-url)
be shown on the laptop screen. The objective of the game was for the subject to try and cooperate with the partner – without being able to talk to each other – in order for both of them to win a prize. Specifically, the experimenter told subjects: ‘‘The objective of the game that we are about to play is to cooperate with the child from the other kindergarten so that both of you win some stickers. I will show you a number of boxes, and you will have to hide one of the stickers in one of the boxes. The child from the other kindergarten will then try to guess in which box you hid the sticker. If s/he succeeds in guessing in which box you hid the sticker, then both of you will win the prize! If the other child does not guess the right box, then neither of you will win the prize. So you need to try and hide the stickers in the box that you think the other child will choose!’’. Subjects were told that their partner heard the same instructions, i.e., the partner was aware that the subject would try to cooperate.

The subject was then presented one of the videos displaying either a same- or a different-culture partner. Each ‘‘partner’’ in the video introduced him/herself by name, and offered the subject to play with him/her – all done either in Hebrew or English, depending on the trial. After showing the video, the experimenter told subjects, ‘‘see, this child is Israeli and speaks Hebrew’’, or ‘‘this child is from England. He/she does not understand or speak Hebrew, and does not know Israel. He/she is asking whether you want to play with him/her’’.

After the video, the experimenter placed the boxes for that particular trial on the table. While organizing the boxes, the experimenter confirmed that the child understood the various cues attached to the boxes. For instance, in the visual trials, the experimenter said: ‘‘Look, every box has a flag on it. This one has a flag we don’t know, this one has the Israeli flag which we know, and here is one with flags of all the countries in the world – Israel, USA, England, etc.’’ In the verbal trials, the experimenter said: ‘‘Look, these boxes have words on them; I’ll read them to you. This one says, ‘I don’t know’, this one says, ‘maybe’, and this one says, ‘sticker’’. After either of these descriptions, the experimenter disclosed to the subject the individual cue, hidden inside one of the boxes.

Once the description of the boxes was completed, the experimenter reminded subjects that they must now choose where to hide the prize, and that they should choose the box which they think the video-partner will choose. For instance: ‘‘Now you need to cooperate with [Yair, who lives in Israel and speaks Hebrew/Michael who lives in England and does not speak Hebrew], so try and hide the sticker where you think [Yair/Michael] would also look for it. Which box do you want to put the sticker in?’’ Children responded by pointing to one of the boxes, the experimenter recorded their response, and then the next trial was presented.

Each child completed four trials. Each trial involved a different partner, so that subjects would not consider formulating a permanent strategy. Order of presentation of the trials was counterbalanced across subjects, with the constraint that the cultural membership of the partners was blocked. Thus subjects either saw two trials involving a same-culture partner first and two involving a different-culture second, or vice versa. Also counterbalanced was whether subjects first saw a verbal or a visual trial. Lastly, the order of presentation of the cues was also counterbalanced within- and between-subjects. The experimenter reminded children of the game’s objective before each trial. Importantly, the supposed choice made by the partner was not shown to the subjects after each trial, but rather only at the very end of the procedure. This way subjects did not get online feedback as to whether their choices were successful. This feature was explained to children at the beginning of the game. At the end of all four trials, the experimenter told children: ‘‘Well done! Now I will send your answers to the experimenter in the other kindergarten, and check if you succeeded in choosing the box the other child also chose’’.

The experimenter then simulated sending a message with the subject’s responses via her mobile phone. After a short wait, the experimenter simulated reading a message on her phone, and told the subject: ‘‘Good, you did really well’’, thus awarding them the stickers they had chosen in the beginning of the experiment.

2.2. Results

Our main hypotheses regarded the frequency with which children would choose the cultural cue. Specifically, we predicted that: (a) children would choose the cultural cue more often when playing with a same- than with a different-culture partner, and (b) when playing with a same-culture partner, children would choose the cultural cue more often than the universal cue, and vice versa for when playing with a different-culture partner. In order to assess these hypotheses, we conducted two sets of analyses: parametric ones collapsing across trial type, and non-parametric ones looking at each trial type separately.

2.2.1. Parametric analyses

A repeated measures analysis was conducted, with both the partner’s culture (same vs. different) and cue type (individual, cultural, and universal) as the within-subjects variables. The dependent measure was the number of times (0–2) children selected each of the cue types when playing with each type of partner. Preliminary analyses revealed no significant effects of trial order (visual or verbal 1st, same- or different-culture 1st), nor of gender, and thus data were collapsed across trials, and these factors were not entered into the main analyses.

Results revealed a significant main effect of partner’s culture, $F(1,56) = 6.87, p < 0.05, \eta^2_g = 0.11$, and a significant main effect of cue type, $F(2,55) = 14.79, p < 0.001, \eta^2 = 0.35$. Most importantly, the interaction between cue type and partner’s culture was significant, $F(2,55) = 5.99, p < 0.005, \eta^2 = 0.18$. This interaction is illustrated in Fig. 2.

We followed-up this interaction in a few ways. First, paired $t$-test comparisons indicated that as hypothesized in (a) above, children chose the cultural cue more often when playing with a partner from the same culture ($M = 1.05, SD = 0.64$) than when playing with a partner from a different culture ($M = 0.58, SD = 0.65$), $t(56) = 3.78, p < 0.001$. Partner’s culture did not have a significant effect on either of the other two cue types. Second, and consistent with hypothesis (b) above, Bonferroni post hoc comparisons indicated that when playing with a partner from the same culture, the cue...
type most frequently chosen was the cultural one ($M = 1.05$, $SD = 0.64$), followed by the universal ($M = 0.61$, $SD = 0.70$), and then the individual ($M = 0.30$, $SD = 0.53$) ($ps < 0.05$). The latter two did not differ significantly. In turn, when playing with a partner from a different culture, the universal cue was chosen more often ($M = 0.86$, $SD = 0.79$) than the individual one ($M = 0.37$, $SD = 0.58$) ($p < 0.005$), but not of the cultural one ($M = 0.58$, $SD = 0.65$).

Finally, to further verify the above tendencies, the mean number of times each cue type was chosen when playing with each type of partner, was compared to the expected mean number under random choice – which in the entire game equaled 0.58 ($0.25$ in visual trials + $0.33$ in verbal trials). Results of one sample $t$-tests indicated that when playing with a partner from the same culture, the mean number of choices of the cultural cue was the only one significantly higher than chance, $t(56) = 5.59$, $p < 0.001$. The mean score for the individual cue was significantly lower than chance, $t(56) = -3.99$, $p < 0.001$, and the mean score for the universal cue was not significantly different than chance, $t(56) = 0.37$, $p = 0.71$. In turn, when playing with a partner from a different culture, the mean number of choices of the universal cue was the only one significantly higher than chance, $t(56) = 2.67$, $p < 0.05$. The mean score for the individual cue was significantly lower than chance, $t(56) = -2.72$, $p < 0.001$, and the mean score for the cultural cue was not significantly different than chance, $t(56) = -0.01$, $p = 0.99$.

### 2.2.2. Non-parametric analyses

In our first analysis, we compared the number of children who made cultural and universal choices in the two types of trials, and with each type of partner. None of these comparisons was significant (Wilcoxon's $p's > .05$). Nonetheless, in order to provide a finer-grained description of the data, we conducted two sets of non-parametric analyses to assess children's pattern of responses in each trial type separately.

To assess hypothesis (a), our first analyses assessed the effect of partner's culture on the frequency of choices of cultural and universal cues. Consistent with the parametric analyses, Wilcoxon Signed Ranks Tests revealed that partner's culture did not have an effect on the frequency of choices of the universal cues, but did have an effect on the frequency of choices of the cultural cues. In particular, although the overall pattern was similar in the two trial types (see [Fig. 3](#fig3)), only in the visual trials did significantly more children make cultural choices when playing with a same-culture partner (35 of the 57 children did so) than with a different-culture partner (15 of 57), $Z = 3.33$, $p < 0.005$ (the number of children making cultural choices with same- vs different-culture partners in the verbal trials was 25 and 18, respectively).

To address hypothesis (b), the second analyses assessed the possible effects of cue type within each type of partner and trial. For this purpose, we conducted Goodness of Fit Chi-squares assessing the distribution of children across all the different cue types available in each trial type. Overall, the findings here were also consistent with the parametric analyses. Namely, when playing with a same-culture partner, the distribution of children was significantly different from a random distribution both in the visual, $\chi^2(3, N = 57) = 44.54$, $p < 0.001$, and verbal trials, $\chi^2(2, N = 57) = 6.63$, $p < 0.05$. As can be seen in [Fig. 3](#fig3), in both cases, the most popular choice was the cultural cue. When playing with a different-culture partner, only in the verbal trials was the distribution of children non-random, $\chi^2(2, N = 57) = 9.58$, $p < 0.01$, with the most popular choice being the universal cue.

### 2.3. Discussion

The findings from Experiment 1 were overall consistent with our hypotheses. Namely, children chose the cultural cue more often when playing with someone who presumably shared their knowledge of that cue, than when playing with someone ignorant of that cue. Moreover, children succeeded in adjusting which type of cue to choose, according to their partners' respective knowledge. This was clearest when playing with a same-culture partner, in which cases children privileged the cultural cues. When playing with a different-culture partner, children chose the universal cue significantly more often than chance, but not at a rate statistically distinguishable from the rate of cultural cues choices – a point to which we will return in Section 4. Taken together, these results reveal that even in the absence of direct information about others' knowledge, and quite robustly across somewhat different trial types, young children were capable of making reasonable inferences about the best coordination strategy to engage in with various interlocutors.

The findings of Experiment 1 show that in a game of cooperation, children can identify and use shared knowledge, which serves as a focal point for the optimal coordination of an interaction between them and partners – be the partners from the same or a different cultural group as the child. The purpose of Experiment 2 was to investigate whether children can also use these capacities when competing, rather than cooperating, with others.
3. Experiment 2

3.1. Method

3.1.1. Subjects

Fifty-seven Jewish Israeli children (33 boys, 24 girls) from two kindergartens in the greater Jerusalem area participated in the experiment ($M_{age} = 68.14$ months, $SD = 6.09$, range = 56–83 months). None had participated in Experiment 1. Due to lack of cooperation, data from two additional subjects were not taken into account in the final analyses. Only children with signed parental permission participated.

3.1.2. Materials

The materials were the same as those used in Experiment 1.

3.1.3. Procedure

The procedure in Experiment 2 was identical to that of Experiment 1, with the only difference being the objective of the game. Here, instead of telling children that they should cooperate with the internet partner, children were told that they will be competing with the partner (and that the partner knew that). Specifically, the experimenter told subjects that, “the objective of the game we are going to play is to compete with the child from the other kindergarten, so that only one of you will win the stickers. I will show you a number of boxes, and you will have to hide one of the stickers that you chose in one of the boxes. The child from the other kindergarten will try to guess in which box you hid them. If he/she does not succeed in guessing which box you chose, then only you win the prize. But if he/she succeeds in guessing, then only he/she will win the prize! So you need to hide the stickers in a box where you think he/she will not look for them.”

3.2. Results

As in Experiment 1, our main hypotheses regarded the frequency with which children would choose the cultural cue. Opposite to the predictions in Experiment 1, here we predicted that: (a) children would choose the cultural cue more often when playing with a different- than with a same-culture partner, and (b) when playing with a different-culture partner, children would choose the cultural cue more often than the universal cue. As in Experiment 1, in order to assess these hypotheses, we conducted two sets of analyses: parametric ones collapsing across trial type, and non-parametric ones looking at each trial type separately.

3.2.1. Parametric analyses

A repeated measures analysis was conducted, with both the partner’s culture (same vs. different) and the type of cue given (individual, cultural, or universal) as the within-subjects variables. The dependent measure was the number of times (0–2) children selected each of the cue types when playing with each type of partner. Preliminary analyses revealed no significant effects of trial order (visual or verbal 1st, same- or different-culture 1st), nor of gender, and thus data were collapsed across trials, and these factors were not entered into the main analyses.

Results revealed only a significant interaction between cue type and partners’ culture, $F(2, 55) = 5.64, p < 0.01, \eta^2 = 0.17$. This interaction is illustrated in Fig. 4. We followed-up this interaction in the same ways as done in Experiment 1. First, paired $t$-test comparisons indicated that as hypothesized in (a) above, children chose the cultural cue more often when playing with a partner from a different culture ($M = 0.88, SD = 0.68$) than when playing with a partner from the same culture ($M = 0.44, SD = 0.68$), $t(56) = 3.10, p < 0.005$. Interestingly, children chose the universal cue less often when playing with a partner from a different culture ($M = 0.44, SD = 0.60$) than when playing with a partner from the same culture ($M = 0.79, SD = 0.70$), $t(56) = -2.67, p < 0.05$. Partner’s culture did not have a significant effect on children’s choices of individual cues.

Second, and consistent with hypothesis (b) above, Bonferroni post hoc comparisons indicated that when playing with a partner from the same culture, the universal cue ($M = 0.79, SD = 0.70$) was chosen marginally more often than the cultural cue ($M = 0.44, SD = 0.68$) ($p = .07$), but no differences were found in the comparisons to the individual cue ($M = 0.58, SD = 0.73$). In turn, when playing with a partner from a different culture, the cultural cue ($M = 0.88, SD = 0.69$) was chosen significantly more often than the universal cue ($M = 0.44, SD = 0.60, p < .05$), and again no differences were found in the comparisons to the individual cue ($M = 0.53, SD = 0.73$).

Finally, one sample $t$-test comparisons against chance (chance = 0.58) revealed that when playing with a partner from the same culture, only the frequency of choosing the universal cue was significantly different (higher) than chance, $t(56) = 2.26, p = 0.005$. In turn, when playing with a partner from a different culture, only the frequency of choosing the cultural cue was significantly different (higher) than chance, $t(56) = 3.28, p < 0.005$.

3.2.2. Non-parametric analyses

In our first analysis, we compared the number of children who made cultural and universal choices in the two types of trials, and with each type of partner. None of these comparisons was significant (Wilcoxon’s $ps > .05$). Nonetheless, in order to provide a finer-grained description of the data, we conducted two sets of non-parametric analyses to assess children’s pattern of responses in each trial type separately.

To assess hypothesis (a), our first analyses assessed the effect of partner’s culture on the frequency of choices of cultural and universal cues. Fig. 5 displays the relevant distributions. Consistent with the parametric analyses, Wilcoxon Signed Ranks Tests revealed that partner’s culture had an effect on the frequency of choices of the cultural cues in both the visual, $Z = 2.12, p < 0.05$, and verbal trials, $Z = 2.34, p < 0.05$, with children selecting this cue type more often when playing with a different- than same-culture partner. Regarding the universal cue, although the overall pattern was similar in the two trial types, only in the verbal trials did significantly more children make universal choices when playing with a same-culture partner than with a different-culture partner, $Z = 2.00, p < 0.05$. 

Fig. 4. Frequency of selection of each cue type according to the partner’s culture, in Experiment 2. Note. * = significantly different from chance (chance = 0.58) on one-sample $t$-test. Brackets indicate significant differences between bars. Error bars depict SEs.
To address hypothesis (b), the second analyses assessed the possible effects of cue type within each type of partner and trial. For this purpose, we conducted Goodness of Fit Chi-squares assessing the distribution of children across the different cue types. Overall, the findings here were also consistent with the parametric analyses, though with some variation across trial type. Namely, when playing with a same-culture partner, the distribution of children was significantly different from a random distribution only in verbal trials, $\chi^2(2, N = 57) = 6.00, p = 0.05$. As can be seen in Fig. 5, the least popular choice in that context was the culture cue. When playing with a different-culture partner, only in the visual trials was the distribution of children non-random, $\chi^2(3, N = 57) = 13.11, p < 0.05$, with the most popular choice being the cultural cue.

3.3. Discussion

Overall, the results of Experiment 2 confirmed that also in a competition game, children were capable of regulating their assumptions about others’ knowledge, in order to devise the most efficient strategy to achieve their goal. Thus, when interacting with someone not from their culture, children capitalized on the partner’s ignorance of cultural markers, and when interacting with someone from their own culture, children refrained from using those markers. These modulations in a competitive context are impressive because it required children to: (a) infer the other’s likely epistemic state – as in the cooperation game, but then (b) avoid the result of that inference, selecting instead an alternative option.

In fact, some of the findings suggest that the above latter step indeed proved taxing for children. First, when playing with a partner from the same culture, the optimal strategy would have been to select the individual cue. However, contrary to this postulation, children did not choose the individual cue more often than expected by chance, choosing instead the universal cue. Perhaps children reasoned that as long as they did not hide the sticker in the culturally-marked box they would be safe; however, this strategy was nonetheless logically sub-optimal. Second, when playing with a partner from a different culture, they should have refrained from both the individual and universal cues. Although children did choose the cultural cue more often than the other two, they still chose individual and universal cues no different than expected by chance. We will present some possible explanations for this difference between experiments in Section 4.

Taken together, although the demand to inhibit an inferential conclusion might have taken a toll on children’s performance, children’s overall pattern again manifested nuanced and sophisticated capacities to coordinate actions based on assumptions about others’ varying knowledge states. Moreover, despite differences in the types of cues presented in each trial type, there were no systematic differences in children’s responses to the two types of trial, and the overall pattern in both was similar.

4. General discussion

People are constantly required to coordinate their actions with someone else’s, based on certain expectations about how the other will likely act in a given situation – expectations that are in turn grounded on assumptions about what others know. In game theoretic analyses of such coordination problems, the solutions are defined as focal points (e.g., Schelling, 1960). Grueneisen et al. (2015) have recently demonstrated that by age 5, children are capable of relying on “objectively” prominent focal points. Here we show that 5-year-olds are capable, in fact, of adjusting which focal point to rely on, according to the presumed knowledge of their coordinating partner. To highlight, when the coordination problem required children to cooperate with a partner (Experiment 1), then they were more likely to choose a cultural focal point when playing with a partner from their culture than a partner from a different culture. In turn, when the coordination problem required them to compete with a partner (Experiment 2), children switched the above choice pattern.

This is a fairly remarkable achievement for a number of reasons. First, solving any coordination problem requires children to take someone else’s perspective, assess their epistemic state, and play out a course of action that will lead to a desired outcome. This type of explicit and reflective mind-reading capacity is indeed likely to be achieved around age 5 (Robinson, Rowley, Beck, Carroll, & Apperly, 2006; Wellman, 2014). It is noteworthy that once this conceptual landmark is achieved, children can put it to use in coordination problems. Second, and perhaps even more impressively, solving a coordination problem of the type children faced in the current experiments, requires them to assess someone else’s epistemic state not vis-à-vis a common and physically present reality – as in the case of Grueneisen et al. (2015) where one box was distinctively marked. Rather, the assessment is vis-à-vis the hypothetical knowledge that others carry by nature of being members of a certain cultural group. This is quite complicated a task, because knowledge does not come “tagged” as to whether it is universal,
cultural, or idiosyncratic. Instead, children have to guess how widely known are various pieces of information they are exposed to. There is some sparse evidence regarding children's capacity to differentiate between who knows what based on group membership (Diesendruck, 2005), and expertise (Keil, Stein, Webb, Billings, & Rozenblit, 2008). The present studies add to these findings, and show how at age 5 children can actively use their differential assessment for coordinating behaviors.

It is important to acknowledge two possible qualifications to the above conclusion. First, it could be argued that rather than acting on assumptions about what others know, children were acting on assumptions about what others like. It seems to us, however, that even if the proximal cause for children's behavior was an evaluation of what their partner likes (e.g., that an Israeli partner might like the Israeli flag best), there is quite plausibly some differential assumptions about what their partners know underlying these preferences. In other words, why would an Israeli, but not a British, partner like the Israeli flag best? Moreover, it seems that the "preferences" account would be less plausible for the verbal trials, wherein children's decisions varied simply according to the labels attached to the boxes. There it seems that the choice of a box with the label "sticker" affixed to it when cooperating with a same-culture partner, likely derived from the assumption that that partner could understand that label.

A second caveat is that although we have emphasized the idea that children modulate their choices based on assumptions about others' cultural knowledge, we do not believe that the conclusions apply exclusively to such cases. Rather, just as certain cues might be especially prominent for members of a particular cultural group (e.g., a country's flag), so there are other cues that might be especially prominent for members of various other types of social groups (e.g., based on gender, ethnicity, university-affiliation, etc.). And given the findings revealing young children's rich assumptions and expectations about social groups (e.g., Diesendruck & haLevi, 2006; Dunham et al., 2011; Shutts et al., 2013), we believe children would be capable of succeeding in tasks similar to the ones used here that provided "social group markers" instead of cultural ones. In fact, arguably one of the functions of social categorization is to demarcate the boundaries of shared knowledge, not only for the sake of making communication with others effective, but also to define from whom to learn.

In fact, the present findings indicate that demarcating such boundaries, even vis-à-vis cultural group members, is somewhat challenging to 5-year-olds. For instance, based on a strictly logical analysis of what others might know, children in Experiment 1 could have inferred that same-culture partners share with them not only the cultural cue, but also the universal one. Contrary to this inference, when interacting with a same-culture partner, children selected the universal cue no different than chance. One possible explanation for this finding – especially in the visual trials – is that children had difficulty recognizing the "universal flags" as indeed representing various countries. A more general explanation for this finding is that when put in a situation in which they had to choose between hiding the sticker in the culturally-marked box or the universally-marked one, children went for the pragmatically most relevant one (Sperber & Wilson, 1986). In other words, given that logically they were equally plausible, and yet the prize could be hidden in only one, children selected the box that was most informationally selective to that particular partner.

A second interesting difficulty manifested in children's behavior in Experiment 1, is that when interacting with a different-culture partner, children selected the culturally-marked box no different than chance. This is somewhat surprising, because, in that type of situation, we might have expected children not to choose that box at all. One possible explanation for this pattern has to do with the notion of children being subject to a "curse of knowledge," namely, children's – and adults' – tendency to exaggerate how widely known is information that they know (Birch, 2005). Thus, our Israeli participants might have assumed that the flag of Israel is a salient cue not only for their compatriots, but for all people. Interestingly, however, even though such a curse might have affected children's assumption about the omniscience of cultural cues, it did not seem to affect their assumption about the privacy of individual cues. Recall that, as hypothesized, children in Experiment 1 indeed selected individual cues less often than expected by chance, when interacting with either a same- or a different-culture partner. Once again, then, we see these results as showing the nuanced and sophisticated ways in which children reason about others' epistemic states in an action-coordination situation.

The results of Experiment 2, on the one hand demonstrate the robustness of children's capacity to coordinate their actions according to a partner's presumed knowledge state, but on the other hand, highlight the particular difficulties the competition set-up entailed. As can be seen in Fig. 2, in Experiment 1 children succeeded in systematically making a "correct" choice in 4 out of the 6 cells of the design. The two cells in which their behavior deviated from what was logically expected were the ones discussed above: choosing the universal cue at chance when playing with a partner from the same culture, and choosing the cultural cue at chance when playing with a partner from a different culture. In comparison, as can be seen in Fig. 4, in Experiment 2 children succeeded in systematically making a "correct" choice in only 1 out of the 6 cells of the design: namely, choosing the cultural information when playing with a partner from a different culture. (Note that the choice of the universal cue when playing with a partner from the same culture, although significantly different from chance, did not constitute a logically correct strategy.)

We offer three possible explanations for this difference between the two scenarios. First, as noted earlier, the demands on mind-reading and related capacities were likely more strenuous in Experiment 2 than Experiment 1. After all, in Experiment 2, not only did children have to make an inference about the partner's mental state and his/her consequent likely course of action, but children had to then not follow that course of action. In other words, children had to inhibit the response resulting from their inferential process, a capacity that also undergoes substantial development in this age (Diamond, 2013; Garon, Bryson, & Smith, 2008). It is interesting in this regard that there is some evidence for differences in the mind-reading related brain circuitries selectively active when adults are involved in competitive and cooperative interactions (Decety, Jackson, Sommerville, Chaminade, & Meltzoff, 2004), and when adults are asked to reason about the mental states of in- vs out-group members (Mitchell, 2009).

A second complication in Experiment 2 is that, as Lewis (1969) discussed, coordination problems require not only an assessment of what others know, but also assessments of what others know that I know, and so on, and the consequent plausible plans of actions I might undertake. In the case of cooperation, that assessment leads to a fairly straightforward answer: the partner knows that the subject wants to cooperate, and thus will likely choose a focal point to hide the prize. But in the case of competition, that assessment – if made – does not lead to a unique solution. If the partner knows that the subject wants to compete, that can lead the partner to infer that the subject will not hide the sticker in the focal point. But if the partner thinks that the subject thinks that the partner will think that, then the partner might infer that the focal point is precisely the place where the subject will hide the prize! A recent study indicates that adults are quite aware of the above requirement in certain coordination games, and successfully navigate them (Kyle et al., 2014). We do not have direct evidence as to whether our 5-year-old subjects engaged in such recursive
reasoning. Nonetheless, it is possible that this additional reasoning demand made the competition scenario even more difficult.

A third, related, intriguing account of the difference between the two scenarios has to do with more general claims about the engagement of mind-reading in cooperative versus competitive situations. In particular, Tomasello and colleagues have advanced the idea that human’s sophisticated social-cognitive capacities are what allowed the acquisition of culture (Tomasello, Carpenter, Call, Behne, & Moll, 2005). Specifically, by having the capacities to engage in joint action planning and share mental states, humans became capable of cooperating, which in turn was a prerequisite for the formation and transmission of culture. Others too have emphasized the primacy of cooperation as a driver was a prerequisite for the formation and transmission of culture (Rand & Nowak, 2013), and the division of cognitive labor: An emerging understanding of how knowledge is clustered in other minds. Cognitive Science, 32, 259–300.

In conclusion, the present studies show that by age 5, children are capable of strategically modulating their choice of focal points in coordination problems, without communication, according to their partners’ presumed knowledge of relevant cues in a situation. This is a key developmental achievement, guiding children to become competent social inter-actors.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.cognition.2015.12.016.

References


