

Observers use coordination as a cue to children's commitment in joint action

Abstract: Previous research has shown that observers can infer the degree of commitment two adult agents have to a joint activity by assessing the degree of coordination between them. Specifically, higher levels of coordination yield higher levels of perceived commitment. In this study we extend this research into a new domain: our participants observe interactions between adults and children. Participants watched short video clips that displayed three baseline rounds (rounds without distraction game) of a joint activity (ball game) between an adult and a child. Those interactions had three different levels of coordination i.e. Low Coordination, High Coordination and High Coordination with Ostensive Cues. Our participants were divided into three groups that corresponded to each level of coordination. After watching the short video clips, they assessed the level of commitment and coordination. We also asked participants to provide information about their level of experience with children; this enabled us to test whether participants with a higher degree of experience would be better at estimating the number of rounds they expected the child to complete. In agreement with previous findings, our results showed that participants' ratings of children's commitment and coordination was significantly higher in the High Coordination and High

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Coordination with Ostensive Cues conditions than in the Low Coordination condition. Furthermore, there was a significant correlation between their ratings of perceived commitment and coordination. However, there was no significant correlation between participants' accuracy and their level of experience.

Keywords: coordination, commitment, joint action, development, ostension

Commitment is a key building block for human social life. Commitments make individuals' behavior predictable in the face of fluctuations in their desires and interests, thereby facilitating the planning and coordination of joint actions involving multiple agents and stabilizing human cooperation (Michael and Pacherie, 2015). While commitments are sometimes made explicit – e.g., through promises or other forms of explicit communication – an implicit sense of commitment can also serve the function of stabilizing cooperation (Michael, Sebanz, & Knoblich, 2016a). This raises the question as to what factors give rise to or enhance an implicit sense of commitment.

Coordination may be one factor (Michael, Sebanz, & Knoblich, 2016b): When two agents coordinate their contributions to a joint action, they form and implement interdependent, i.e. mutually contingent, action plans. Each agent must therefore have, and rely upon, expectations about what the other agent is going to do. An important consequence of this is that an agent's performance of her part within a highly coordinated joint action signals her expectations about the other agent's upcoming actions, as well as her reliance upon those expectations. This may generate social pressure on the other agent to perform her

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contribution in order to avoid disappointing the other's expectation and wasting her efforts. If this is correct, then an observer who takes the perspective of one of the agents involved in the joint action may sense this and expect the agents involved to remain engaged until the goal is completed, and to resist distractions and tempting alternative options.

And indeed, Michael et al. (2016b) reported that when adult participants observed videos of two actors engaged in a joint action, they rated those interactions with a higher degree of coordination as involving a higher degree of commitment. Moreover, McEllin, Felber, & Michael (Under Review) directly manipulated the degree of coordination in joint actions involving two adults, and found that participants were more committed to a partner with whom they had experienced a higher degree of coordination. Although there is no direct behavioral evidence that coordination enhances commitments in children, some recent studies provide reason to expect that it might be the case. For example, a series of experiments by Cirelli et al. (2016) showed that children were sensitive to coordination and that it boosted their prosocial motivation.

A second factor which may boost commitment in everyday joint actions is the use of ostensive cues – i.e. gestures, including eye contact, with which individuals intentionally draw attention to the fact that there is joint attention, typically with the further intention of communicating some request or information (Siposova et al., 2018). For example, just by making eye contact with our dinner host and raising our eyebrows, we can communicate that we want our wine glass filled (Grice, 1975; Sperber & Wilson, 1986). This may be due to an evolved tendency to expect others' eye gaze direction to be a useful source of information, and eye contact to indicate another agent's ability and willingness to contribute to one's goals (Emery, 2000; Friesen, C.K., Kingstone, A., 1998). In the context of a coordinated joint action, ostensive cues, including eye contact, may be interpreted as indicating expectations

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about actions contributing to the goal of the joint action, and may therefore tend to generate social pressure to perform those actions.

In support of this, studies by Goldman & Fordyce, (1983) and Manesi et al. (2016) report evidence that ostensive eye contact promotes prosocial behaviour in adults. In addition, Wyman et al. (2013) showed that ostensive eye contact increased children's cooperative behaviours in a social dilemma, and Siposova et al. (2018) demonstrated that ostensive eye contact both promoted expectations of cooperation and also signalled a commitment to cooperate for children.

This previous research raises the question of whether adult perceivers' expectations about interactions involving coordination and/or ostensive eye contact extend to joint actions involving children. In particular, do adult perceivers attribute a higher degree of commitment to children engaged in joint actions with a high degree of coordination? If so, is this all the more true if the coordination is highlighted by ostensive cues? To address this, the current study aims to investigate whether adult-child joint actions with higher levels of coordination – with or without ostensive cues – are perceived as involving higher levels of commitment.

Moreover, if children's commitment to joint actions is modulated by the degree of coordination within the joint action, and by the presence or absence of ostensive cues, then we should expect adult perceivers with a high degree of experience with children to be particularly sensitive to these cues, and to use them to estimate the children's degree of commitment to the joint action. If so, we should expect adult observers with more experience with children to be more accurate in their estimates of children's commitment than adult observers with less experience with children.

Thus, the study was designed to test the following two hypotheses:

Hypothesis 1: The perception of coordination boosts perceived commitment.

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Hypothesis 2: Adults' ability to accurately perceive commitment in adult-child joint actions is influenced by their personal experience with children (i.e. as caregivers, teachers, students, babysitters etc.)

To test these hypotheses, we used video clips from a previous study (BLIND et al., in prep) with 4-year-olds, in which children's commitment to completing a joint task with an adult was measured in terms of how long they persisted before being lured away by a tempting alternative game. In this study, the degree of coordination between child participants and an adult experimenter was experimentally manipulated, as was the presence or absence of adult-administered ostensive cues.

In the current study, participants were recruited online and divided into three groups, one for each of the three experimental conditions implemented in BLIND et al's study: Low Coordination (i.e. Low Coordination and no ostensive cues); High Coordination (i.e., coordination without ostensive cues); High Coordination with Ostensive Cues (i.e. coordination with ostensive cues). Next, they were shown brief video clips of a child and an adult experimenter performing a joint task from BLIND et al's (in prep) study, and presented with a series of test questions. To test hypothesis 1, participants were asked to rate the level of commitment they perceived in the joint action on a 6-point scale. Hypothesis 1 led us to predict that participants in the High Coordination with Ostensive Cues condition would perceive the highest degree of commitment, followed by participants in the High Coordination condition, with participants in the Low Coordination condition perceiving the lowest degree of commitment.

As a further test of hypothesis 1, participants were asked to what extent they perceived the joint action to be coordinated. We expected that participants who perceived higher levels of coordination would also perceive higher levels of commitment -- irrespective of the

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experimental condition. Additionally, this question served as a manipulation check to ensure that participants in the conditions with coordination in fact perceived a higher degree of coordination than participants in the condition without coordination.

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To test hypothesis 2, we also asked participants to indicate their level of experience/expertise with children. Hypothesis 2 generates the prediction that caregivers and others with extensive experience with children should be more accurate in estimating how long the children persisted in joint action before being lured away by a tempting alternative game. This was assessed by comparing the responses to the question with the actual number of rounds completed by the child.

Method

The hypotheses, sample size, methods, exclusion criteria and planned analyses were pre-registered before data collection and can be accessed at: <https://aspredicted.org/543mq.pdf>.

All aspects of the study were carried out in accordance with the pre-registered protocol unless otherwise stated.

Participants

Using an online testing platform, we recruited 132 participants from among XXXX University students. Of these, we excluded the data from 29 participants who failed to respond correctly to the three control questions (see below), and one further participant who was deemed an outlier (see below). This left a sample of 102 participants (53 females, 43

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males, 6 participants chose not to disclose their sex; mean age = 21.6, $SD=2.9$). The experiment was conducted in accordance with the Declaration of Helsinki, and was approved by the Humanities & Social Sciences Research Ethics Sub-committee (HSSREC) at the University of XXXXX (approval number: 01/16-17), as part of the ERC-funded project ‘[XXXXX]’.

A between-subjects design was employed, with three conditions: High Coordination with Ostensive Cues, High Coordination, and Low Coordination.

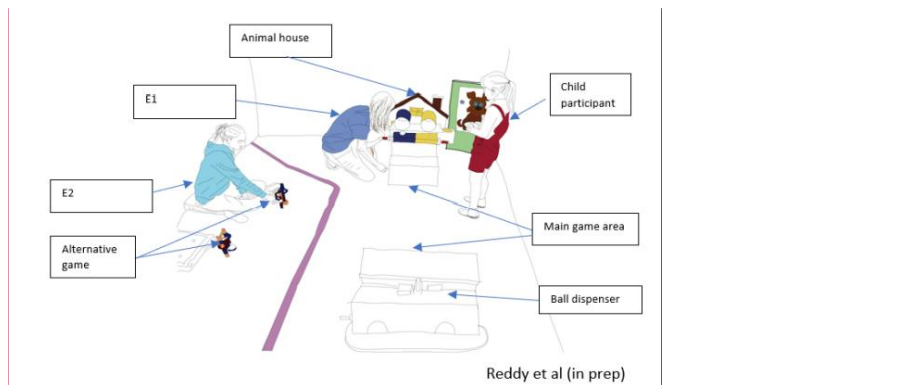
Participants were randomly assigned to the three groups and shown clips of videos from a previous experiment involving joint actions between an adult and a child (see **Fig. 1**).

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Stimuli

The stimuli for the current study were drawn from a previous experiment by BLIND et al (in prep) (See **Fig. 1**). In BLIND et al.’s study, 4-year-old children were introduced to a main game played together with Experimenter 1 (E1): taking balls from a dispenser to a house to give to an animal. The balls were lifted in a lift until they fell into tubes that led into the house. After three (baseline) rounds of this game, Experimenter 2 (E2) started playing a new exciting game, thereby presenting the children with a tempting alternative to the main game. The experiment investigated whether the degree of coordination and presence or absence of ostensive cues from E1 influenced how long the children stayed committed to the main game before switching to the alternative game.

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Figure 1. The Setup in BLIND et al. (In Preparation). Figure 1 shows the scene that was observed by our participants. E1 is playing the main game with the child (taking the balls from the ball dispenser to the animal house). E2 is attempting to distract the child by playing an enticing alternative game.

In the current study, participants in the **High Coordination with Ostensive Cues** condition viewed approximately one-minute video clips from BLIND et al's study, showing E1 actively coordinating with the child. That is, she walked to the animal house with her ball and waited there for the child to come so that they could put their balls in the lift together. In addition, E1 used ostensive cues to let the child know she was waiting for them and that she intended to complete the action of lifting the lift together – i.e., holding the ball up while waiting, engaging in ostensive eye contact, and saying the child's name directly before putting the balls into the lift and lifting them together.

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Participants in the High Coordination condition saw interactions which differed only in that E1 did not display ostensive cues to the child. The amount of eye contact however remained constant – i.e. E1 said the child's name and made eye contact with the child once per round in a manner that was unrelated to the coordination.

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Participants in the **Low Coordination** condition saw interactions which differed in that E1 did not wait to coordinate with the child, but instead placed the ball into the lift and lifted it alone, and also did not display ostensive cues to the child. As in the High Coordination condition, saying the child's name and eye contact remained constant.

Procedure

Participants were invited to complete an online study and provided with general information about the procedure before giving their informed written consent. Next, they completed a familiarisation phase, followed by the test phase.

Familiarisation Phase

Participants were presented with a brief text to familiarise them with the scenario in the videos (described above). Next, participants were shown a 20-second video clip which displayed typical leaving behaviour – i.e., an example of a child leaving the main game to play the tempting alternative game with E2.

Test Phase

First, participants were shown a one-minute video clip which displayed the three baseline rounds from BLIND et al's experiment – i.e. E1 and the child completed three rounds, going from the ball dispenser to the animal house three times. The clips did not show subsequent rounds once E2 had initiated the tempting alternative game, so participants did not see how long the children in fact persisted. They were then asked the 'Commitment Question', which

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was designed to test whether participants' perception of coordination would boost perceived commitment (hypothesis 1):

Commitment Question: How strongly do you feel the child is committed to continue playing with the adult? (6 -point scale: 'highly uncommitted', 'moderately uncommitted', 'slightly uncommitted', 'slightly committed' 'moderately committed' 'highly committed').

Next, participants were shown three further one-minute video clips: one of a child who completed a low number of rounds, one of a child who completed an intermediate number of rounds, and one of a child who completed a high number of rounds. These were presented in randomised order. Crucially, the video clips only depicted the first three (baseline) rounds before the tempting distraction appeared, so participants could not ascertain how many rounds the child completed. After each video clip, they were presented with the 'Persistence Question':

Persistence Question: Judging by what you observed in the video, how many rounds of the current game will the child complete? The game has a maximum of 9 rounds (response options: none, 2-3 more rounds, 4-5 more rounds, 6-7 more rounds, all 9 rounds).

By comparing participants' responses to this question with the children's actual behaviour, we were able to ascertain participants' accuracy at perceiving commitment. For each correctly predicted number of rounds our participants received 1 point. Thus, their accuracy score was assessed on a 0-3 scale.

Next, we showed participants the same three videos with respect to which they had been asked the persistence question (in randomised order). This time, we presented them with the 'Coordination Question' after each video clip:

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Coordination question: To what extent did the child and the adult appear to you to be coordinated while playing the ball game? (6 -point scale: 'highly uncoordinated', 'moderately uncoordinated', 'slightly uncoordinated', 'slightly coordinated' 'moderately coordinated' 'highly coordinated').

This question served as a manipulation check to ensure that participants in the conditions with coordination in fact perceived a higher degree of coordination than participants in the condition without coordination. It also provided a further test of hypothesis 1, allowing us to test whether participants who perceived a high degree of coordination (irrespective of the experimental condition) also perceived a high degree of commitment.

Then, participants answered a further question which enabled us to ascertain the impact of their experience with children upon their accuracy in perceiving commitment (hypothesis 2):

Experience question: How much experience have you had with children (for example as tutors, babysitters, teachers etc.)? (5-point scale ranging from 'none at all' to 'extensive experience')

Finally, in order to ensure a high quality of data, the following control questions were included -- i.e. to filter out bots as well as participants who did not pay close attention to the video clips presented: 1) How many dogs did you see in the videos? (response options: none, 2, 3, 5). 2) Did the videos display a scene at: (response options: the seashore, the mountains, in a room, on a volcano). 3) How many people did you see in total? (response options: Fewer than 20, 20-40, 40-60, more than 60).

Results

Exclusions

We first excluded participants who failed to answer all three of the control questions correctly (29 participants). In addition, one data point was identified as an outlier and excluded from the dataset. This anomalous response, which occurred in the High Coordination condition, was the only one to rate the perceived interaction as ‘highly uncoordinated’. We decided to remove this data point in order to ensure that any effect of perceived coordination on any of our dependent variables was not distorted or masked (e.g., due to overfitting) by this sole data point.

Analyses

We first assessed our data using the Shapiro-Wilk test and determined it to be not normally distributed ($p < .001$). This warranted the adoption of nonparametric methods.

Manipulation check: Coordination ratings by condition

As a manipulation check, we probed whether participants perceived a difference in the degree of coordination between conditions (See **Fig. 2**). The Kruskal Wallis test revealed a significant difference between the conditions for the perceived coordination estimates $H(2) = 36.36, p < .001$. Post-hoc Mann-Whitney tests were used to compare all pairs of groups. They revealed that coordination estimates were significantly higher in the High Coordination with

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Ostensive Cues condition ($Mdn = 5$, $IQR = 4 - 5$) than in the Low Coordination condition ($Mdn = 3$, $IQR = 2 - 3.5$), $U(Noc = 34, Nnc = 33) = 128.50$, $z = -5.58$, $p < .001$, as well as between High Coordination ($Mdn = 3$, $IQR = 2 - 3.5$) and Low Coordination conditions $U(Nnoc = 34, Nnc = 33) = 863.00$, $z = 3.94$, $p < .001$. There was also a significant difference in coordination estimates between the High Coordination with Ostensive Cues and High Coordination conditions $U(Noc = 34, Nnoc = 34) = 350.00$, $z = -2.93$, $p = .003$. This means that the manipulation check effectively confirmed the intended perceived differences between the conditions.

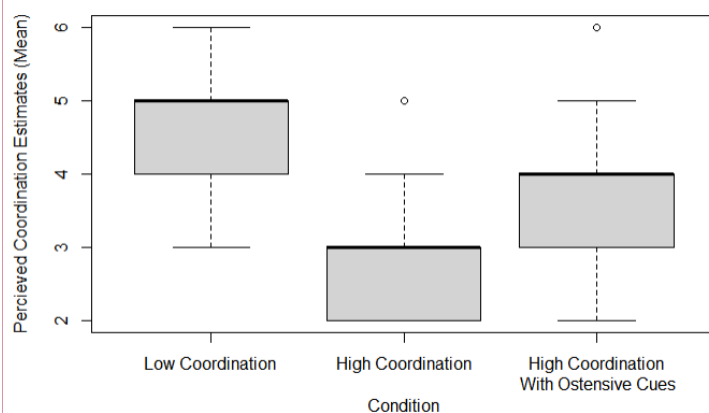


Figure 2. Box and Whisker plot displaying the median and IQR of perceived coordination estimates across Low Coordination ($n = 34$), High Coordination ($n = 33$) and High Coordination with Ostensive Cues ($n = 34$).

Hypothesis 1: The perception of coordination boosts perceived commitment.

Performing a Shapiro-Wilk test determined our data to be non-normally distributed ($p < .001$). This warranted the adoption of nonparametric methods.

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To test hypothesis 1, we first performed a Kruskal Wallis test probing whether participants' responses to the commitment question differed by condition (See **Fig. 3**). The Kruskal Wallis test revealed a significant difference of condition for perceived commitment $H(2) = 19.81, p < .001$. Post-hoc Mann-Whitney tests were used to compare all pairs of groups. They revealed that commitment estimates were significantly higher in the High Coordination with Ostensive Cues condition ($Mdn = 6, IQR = 5 - 6$) than in the Low Coordination condition ($Mdn = 3, IQR = 4 - 6$), $U(Noc = 34, Nnc = 33) = 265.00, z = -3.91, p < .001$, and also significantly higher in the High Coordination condition ($Mdn = 6, IQR = 2 - 5.5$), than in the Low Coordination condition $U(Nnoc = 34, Nnc = 33) = 836.00, z = 3.59, p < .001$. No significant differences in commitment estimates were observed between the 'High Coordination with Ostensive Cues', and High Coordination conditions, $U(Noc = 34, Nnoc = 34) = 265.00, z = -3.91, p = .455$. This result supports hypothesis 1.

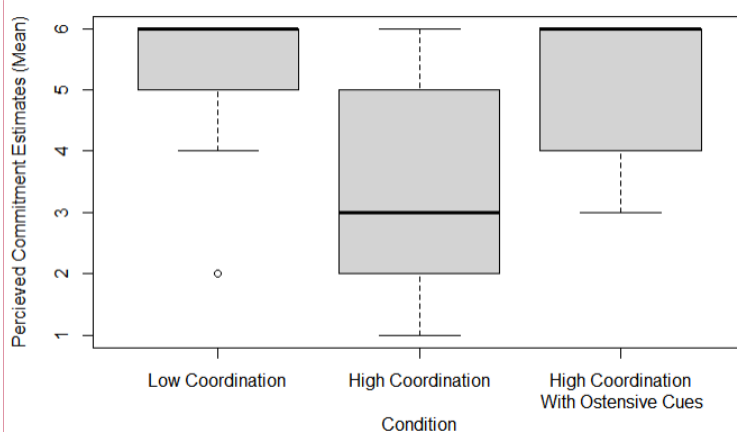


Figure 3. Box and Whisker plot displaying the median and interquartile range (IQR) of perceived commitment estimates across Low Coordination ($n = 34$), High Coordination ($n = 33$) and High Coordination with Ostensive Cues ($n = 34$).

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We assessed the normality of our data by examining the QQ plots, and established that the data were indeed normally distributed. This warranted the adoption of a mixed linear model of regression.

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The mixed linear model of regression displayed the extent to which perceived coordination (responses to the Coordination Question) predicts Commitment (responses to the Persistence Question) modulated by each of our participants. The model explained about 40% of variance. Our model indicates that for every increase in a level of perceived coordination, perceived commitment (operationalised in terms of anticipated persistence) increased by 0.21, $t = 4.94$, $p < .001$, $\beta = 0.21$.

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In sum, the data support the hypothesis that higher perceived coordination leads to higher perceived commitment: Perceived commitment levels were significantly higher in the High Coordination with Ostensive Cues and High Coordination conditions in comparison to the Low Coordination condition, and participants' coordination estimates were correlated with their commitment estimates.

Hypothesis 2: Adults' ability to accurately perceive commitment in adult-child joint actions is influenced by their personal experience with children (i.e. as caregivers, teachers, students, babysitters etc.).

To test hypothesis 2, we first carried out a Spearman correlation test, which indicated that there was a weak negative correlation and a statistically insignificant relationship between the participants' accuracy score and the reported level of experience ($r_s = -.083$, $p = .204$, $N = 101$). This finding is not consistent with hypothesis 2.

As an exploratory analysis, we also conducted a Kruskal Wallis test to probe whether

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accuracy differed by experimental condition (See **Fig. 5**). The results revealed a significant difference between the condition and the participants' accuracy $H(2) = 28.55, p < .001$. Post-hoc Mann-Whitney tests were used to compare all pairs of groups. They revealed that accuracy scores were significantly higher in the High Coordination with Ostensive Cues condition ($Mdn = 1, IQR = 0 - 1$) than in the Low Coordination condition ($Mdn = 0, IQR = 0$), $U(Noc = 34, Nnc = 33) = 227.00, z = -4.96, p < .001$. They were also higher in the High Coordination condition ($Mdn = 1, IQR = 0 - 1$) than in the Low Coordination conditions $U(Nnoc = 34, Nnc = 33) = 876.50, z = 4.76, p < .001$. No significant differences were observed between the High Coordination with Ostensive Cues and High Coordination conditions $U(Noc = 34, Nnoc = 34) = 537.00, z = -.56, p = .577$.

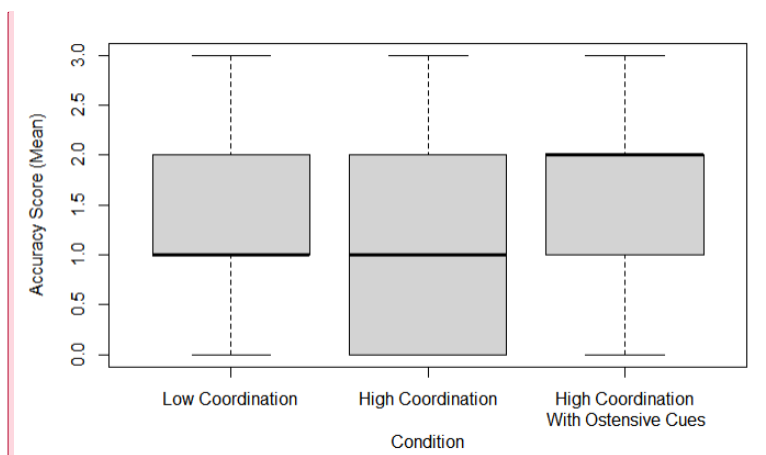


Figure 5. Box and Whisker plot displaying the Median and IQR of accuracy scores across Low Coordination ($n = 34$), High Coordination ($n = 33$) and High Coordination with Ostensive Cues ($n = 34$).

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Given the significant effect of condition upon accuracy, we also carried out a further exploratory analysis to ascertain whether the effect of condition upon accuracy interacted with experience: a generalised linear mixed model with an ordinal logistic response indicated

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no collective effect between the accuracy scores and the level of experience; Wald $X^2(1, N = 101) = .91, p = .340$. We did find a significant main effect of condition on accuracy; Wald $X^2(2, N = 101) = 18.48, p < .001$. The model without the interaction between accuracy and condition achieved an overall better model fit ($AIC = 70.30$) than the model with the interaction ($AIC = 71.43$).

In sum, although we did see a significant difference of experimental condition upon accuracy, the results did not support hypothesis 2: Participants' accuracy scores did not have any significant relationship with their reported experience levels.

Discussion

When adult participants observed video clips of a child and an adult performing the joint action, their ratings of children's commitment were significantly higher **when the child and the adult coordinated their activity** (in the High Coordination with Ostensive Cues and High Coordination conditions) compared to **situation with less coordination** (Low Coordination condition). Moreover, there was a significant correlation between perceived commitment and perceived coordination irrespective of experimental condition. Taken together, these findings provide support for the hypothesis that **the perception of coordination boosts perceived commitment (hypothesis 1)**. It is also worth highlighting that our manipulation check confirmed that participants indeed perceived the conditions with greater coordination as being more coordinated. They even rated the coordination with ostension condition as significantly more coordinated than the coordination only condition, suggesting that the addition of ostensive cues made the joint action appear more coordinated.

Interestingly, however, the results indicate that our participants' estimates of

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commitment were not sensitive to ostension – i.e. they did not perceive a significantly higher degree of commitment in the High Coordination with Ostensive Cues condition than in the High Coordination. This is despite the fact that we did observe a significant difference between High Coordination with Ostensive Cues and High Coordination in our manipulation check (i.e. they perceived a higher degree of coordination in the High Coordination with Ostensive Cues condition than in the High Coordination condition). One possible explanation for this pattern is that the coordination question (which always came after the commitment question) caused participants to notice the visual ostensive cues, or to re-evaluate their relevance, leading them to give higher estimates of coordination. An alternative explanation lies in the design of the experiment: our participants viewed each video clip twice and therefore could pick up on more cues on their second viewing.

These findings build upon previous research that found the degree of interpersonal coordination observed between two adult agents in a joint action to enhance observers' perception of those agents' commitment to the joint action (Michael, Sebanz, & Knoblich, 2016b). They also complement research showing that coordination generates important indirect benefits by boosting prosocial attitudes and motivations: strengthening social bonds (Reddish 2012), enhancing trust and rapport (Hove & Risen, 2009; Launay et al., 2013) and increasing cooperation and helping (Wiltermuth & Heath, 2009; Reddish et al., 2013). Our findings extend this previous research into the domain of joint actions involving children. This may have important implications with respect to teachers' observations of children's interactions in the classroom: children who are more coordinated with the teacher or with their peers may be perceived as being more committed to their learning, and may potentially be perceived as requiring less help.

It is important to acknowledge, however, that participants in the conditions with

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greater coordination may have given higher estimates of commitment because the coordinated joint action appeared to be more fun for the children, or because the children appeared more comfortable with the experimenter when there was greater coordination. Indeed, previous research does indicate that coordination generates rapport (Miles et al., 2009). In future research, this could be investigated by asking participants how much fun they believe the child to be having.

Unexpectedly, the results revealed that our participants' accuracy was affected by the condition they were in. Specifically, they were significantly more accurate when observing an interaction with coordination (i.e. High Coordination or 'High Coordination with Ostensive Cues') than when observing an interaction without coordination. One possible reason for this is that the Low Coordination condition provided fewer visual cues and therefore restricted participants' accuracy.

The findings did not support our second hypothesis: There was no significant effect of participants' reported level of experience on their accuracy in assessing the children's commitment to the game. There are numerous possible reasons for this. First, there was a highly uneven spread of the participants within the experience levels (i.e. 50 in the 'Some' vs 15 in 'Not Much' experience levels). We could be more confident in drawing conclusions about the effect of experience if there were an equal number of participants in each of those levels. Additionally, it must be noted that our participants were primarily young adults, aged 18 - 34. Future research should attempt to extend our findings to a broader range of participants. Furthermore, the video clips displayed only the baseline rounds, without the distraction game. Perhaps this simply did not provide sufficient visual cues for adults to accurately assess the level of commitment. Participants with higher levels of experience could potentially benefit from seeing a round with a distraction game present, as this would provide

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more context and potentially a richer set of social cues. A further possibility would be to sample participants on the basis of their experience with children, and to compare individuals with high expertise to individuals with no expertise.

If, on the other hand, hypothesis 2 is not correct, there may be important pedagogical implications: as adults, we may expect that we can estimate children's commitment to an activity by drawing on the same cues as we would draw upon when estimating adults' commitment, but these cues may not be as reliable in the case of interactions involving children. If so, then educators should be cautious in relying on their perceptual abilities to assess children's commitment to learning tasks.

In sum, our research supports previous findings pertaining to the relationship between perceived coordination and commitment, and also extends them by exploring interactions between adults and children. These findings contribute new **insights for theorising** about the mechanisms relating commitment and coordination.

Author Contributions

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Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or

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Coordination as a cue to commitment

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