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Cooperation and preference by peers in early childhood: A longitudinal study

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Abstract

Children who are more proficient in cooperation with peers tend to be more preferred. To date, the development of peer cooperation has been studied mainly in two research traditions, one focusing on action coordination and the other focusing on interaction quality. Both aspects of cooperation are relevant for children's peer relations, but it is unclear whether both aspects of children's earliest cooperation skills predict their later preference by peers after the transition into organized social groups in school. In this study, we assessed coordination proficiency and interaction quality of 181 Dutch children longitudinally from 2 to 4 years of age. No relation between early action coordination and later preference by peers at school was found. However, especially in girls more affiliative and fewer antagonistic behaviors at the age of two predicted likeability among classmates at school at the age of four. The findings shine new light on the earliest foundations of children's peer evaluations.

KEYWORDS

action coordination, cooperation, early childhood, interaction quality, longitudinal, peer preference

1 | INTRODUCTION

From the end of the first year of life, children interact with peers around toys on a regular basis (Eckerman, Whatley, & Kutz, 1975). In their peer interactions, they display affiliative behaviors such as offering toys to each

other, but also antagonistic behaviors such as claiming or taking away toys. By the end of the second year, toddlers begin to cooperate with each other, as their play activities often unfold around a common goal (Brownell, 2011). In school children, behaviors displayed during interactions with peers predict later rejection or preference by peers (e.g., Denham & Holt, 1993; Ladd, Price, & Hart, 1988). However, to date we know little about the development of peer cooperation in early childhood and how it is related to later peer preference. In this study, we examined whether there were individual differences in the development of peer cooperation in early childhood that were predictive of how well children will be liked by their classmates later in development.

To date, the relation between peer cooperation and peer preference has been studied largely within two research lines: one focusing on action coordination (see Brownell, 2011, for a review), and the other focusing on interaction quality by examining how prosocially children behave (see Vaughn & Santos, 2009, for a review). The coordination of a child's actions with those of a peer is often necessary or at least facilitatory for peer cooperation, such as when building a block tower or moving an object together. Action coordination research supposes that children differ in the socio-cognitive skills that are essential for adjusting their actions to one another, such as planning, memory, causal understanding, and sharing desires, and sometimes goals and intentions (Brownell, 2011). In the block tower building example, children need to have the shared intention that they are building a tower and know of each other that they want to do so. Moreover, they have to monitor each other, for example, how they grasp a block and predict where it is going to be placed. They adapt their placement of a block to when and where the block of the peer was placed, or hold the tower to prevent it from collapsing when the other child places a block. In contrast, interaction quality research focuses on social motivation and social skills to explain why children act in a more or less affiliative manner (Over, 2016; Vaughn & Santos, 2009). For example, a child who wants to belong is more eager to engage in positive interactions with the peer. In addition, children with more experience interacting with peers more often ask for a block, instead of taking it away. Within both research lines large individual differences in children's cooperation skills have been found (e.g., Eckerman & Peterman, 2004; Endedijk, Cillessen, Cox, Bekkering, & Hunnius, 2015). However, to date, it is unclear how these skills in early childhood contribute to children's likeability by peers. Studying these individual differences informs our understanding of children's peer evaluations, as peers may evaluate a child more positively when cooperation with the child happens more smoothly or when the child behaves in a more affiliative way toward peers.

1.1 | Action coordination

Individual differences in peer cooperation can be studied by examining the degree to which children adjust their actions to one another, which is important for imitation, team sports, dancing, music making, and during cooperation (Knoblich, Butterfill, & Sebanz, 2011). In order to reach the common goal of cooperative activity, children have to coordinate their actions by timing and sequencing them carefully to each other (Brownell & Carriger, 1990; Brownell, Ramani, & Zerwas, 2006). Children begin to show coordinated activity with peers during toddlerhood (Ashley & Tomasello, 1998; Brownell, 2011; Meyer, Bekkering, Paulus, & Hunnius, 2010), with 18–19-month-old infants coordinating their actions by, for example, pausing their own actions so that a peer can retrieve a toy or by synchronously pulling a handle to elicit a salient action effect (Brownell & Carriger, 1990; Brownell et al., 2006). During the third year of life, children become increasingly responsive to a peer's actions (Brownell et al., 2006) and more proficient at complex cooperation tasks such as those requiring complementary actions (Ashley & Tomasello, 1998; Fletcher, Warneken, & Tomasello, 2012). Action coordination continues to develop throughout childhood, as children become faster and more consistent in their coordination performance (Ashley & Tomasello, 1998; Steinwender, Warneken, & Tomasello, 2010).

Several studies with adults found a relation between action coordination and liking or rapport (Demos, Chaffin, Begosh, Daniels, & Marsh, 2012; Hove & Risen, 2009; Lakens & Stel, 2011). There is one experimental study with children that investigated the effect of action coordination on liking. Five-year olds preferred a hand puppet with which they previously had coordinated their actions in a cooperation task over another hand puppet (Plötner,

Over, Carpenter, & Tomasello, 2015). During this cooperation task the child and the puppet needed to grasp handles at the same time and lift them up together in order to retrieve puzzle pieces from an apparatus. The results of this study suggest that action coordination has an impact on social evaluations. However, to date there are no studies on the role of action coordination with peers in young children's peer relationships.

1.2 | Interaction quality

Individual differences in peer cooperation also can be studied by examining interaction quality, or the frequency of affiliative and antagonistic behaviors. Affiliative behaviors support the interaction, such as offering toys to each other whereas antagonistic behaviors are obstructive for the ongoing interaction, such as claiming or taking away toys. Interaction quality can be studied during cooperation tasks as well as during free play. The majority of research on the correlates of interaction quality and peer acceptance regards concurrent behaviors (at school) in later childhood and adolescence (see McDonald & Asher, 2018, for a review). Consistent with these studies, also concurrent studies in young children have shown that children who display more affiliative and fewer antagonistic behaviors are better liked by peers and less often rejected (e.g., Santos, Peceguina, Daniel, Shin, & Vaughn, 2013; Sette, Spinrad, & Baumgartner, 2013; Vaughn, Vollenweider, Bost, & Azria-Evans, 2003; Walker, 2009). Longitudinal studies with school children have shown that behaviors displayed during interactions with peers predict rejection or preference by peers later in development (e.g., Denham & Holt, 1993; Ladd et al., 1988).

Despite the large number of studies on the relation between interactive behavior quality and peer preference among elementary school-age children, few studies have examined the predictive value of children's earliest interactive behaviors for their later preference by peers when they go to school for the first time. Studies either have investigated the relation between young children's peer interactions and peer relations concurrently (e.g., Santos et al., 2013; Sette et al., 2013; Vaughn et al., 2003; Walker, 2009) or examined children at school age after they already had gained ample experience interacting with peers in organized social groups (e.g., Denham & Holt, 1993; Dodge, 1983; Ladd et al., 1988). Thus, the direction of the relationship remains unclear as children may differ in their peer interaction as a result of their social position in their established social group.

To date, only two studies have explored whether the quality of peer interactions in toddlerhood predicts children's later peer relations in a new social group. Keane and Calkins (2004) followed children from 2 to 5 years of age, but did not find a predictive relation between affiliative and antagonistic behaviors as rated by parents and teachers and later preference by peers. Friedlmeier (2009) found inconsistent results: a positive relation between toddlers' interaction quality and their preference by peers 20 months later for a playgroup of six children who were 10–22 months old during the first assessment, but not for a playgroup of seven 30–42-month olds with a social evaluation 12 months later. It is thus unclear whether the quality of children's interactions with peers in early childhood predicts their later social evaluation by peers (classmates) when they enter a structured social group (school) for the first time.

1.3 | Gender differences

Already in early childhood, boys and girls tend to differ in how they play. Girls display more cooperative, mitigating, or positive behaviors whereas boys more often show competitive and aggressive behaviors (Dodge, Coie, & Lynam, 2006; Holmes-Lonergan, 2003; Lamb & Ahnert, 2006; Maccoby, 2002; NICHD Early Child Care Research Network, 2001). Therefore, children as young as 3–4 years of age prefer interacting with members of the same gender (Fabes, Martin, & Hanish, 2004; Maccoby, 1990). To date, there is limited research on gender-specific predictors of peer evaluation. The few existing studies that examined gender effects found no differences in the relation between interaction quality and social status for boys and girls, but rather a general positive relation between

interaction quality and peer evaluations (NICHD Early Child Care Research Network, 2008; Walker, 2009; Wilson, 2006). However, some studies suggest a more important role of antagonistic behaviors for boys (Keane & Calkins, 2004) and of affiliative behaviors for girls (Mathieson & Banerjee, 2011) for peer preference.

1.4 | Peer evaluations

In summary, previous research suggests that both action coordination and interaction quality impact children's peer evaluations. Examining whether children's skills at the very beginning of social development predict their likeability among peers later in school is important, because children's sociometric choices begin to stabilize from the age of four (Hymel, 1983). Once established, peer status is fairly stable across childhood (Maassen, Steenbeek, & van Geert, 2004; Quinn & Hennessy, 2010; Ramsey, 1995; Walker, 2009; Wu, Hart, Draper, & Olsen, 2001) and has consequences for academic adjustment (e.g., Morris et al., 2013; Wilson, Petaja, & Mancil, 2011) and the development of behavior problems (e.g., Berdan, Keane, & Calkins, 2008; Ladd, 2006; Ladd & Troop-Gordon, 2003).

1.5 | Current study

We followed children from 2 years of age until they were 4 and examined their cooperation with a same-sex peer at three points in time. A cooperation task made it possible to measure both children's action coordination proficiency as well as their interaction quality. In The Netherlands, children start school and thus enter a new social group as soon as they turn 4 years. We assessed children's preference among their new classmates after they entered school and its prediction from children's earlier action coordination and interaction quality during a cooperation task when they were 2–3 years old. We hypothesized that toddlers' action coordination and interaction quality would be fundamental elements of successful early peer cooperation and therefore would predict their peer preference after the transition into a structured peer group at school. We also examined gender differences in the role of action coordination and interaction quality in children's social evaluation after the transition to a structured classroom setting.

2 | METHOD

2.1 | Participants

Participants were 181 Dutch children, who were tested at 28 months (M = 27.97, SD = .31), 36 months (M = 35.93, SD = .31), 44 months (M = 43.85, SD = .32), and 52 months (M = 51.67, SD = 1.17) of age. Dropout rates were low: The sample consisted of 180 children at 28 months, 164 at 36 months, 160 at 44 months, and 167 at 52 months. Of all children, 48% were boys. Children were selected from a database of families in the Nijmegen area (a middle-size Dutch city with approximately 165,000 inhabitants) who were willing to participate in research with their child. All families from the database were approached who had a child within the desired age range (28 months plus/minus 2 weeks). Children spoke Dutch and came from mixed socioeconomic backgrounds, with 15.3% of the children having parents who completed secondary education or vocational training, 20.5% having one parent who followed higher education, and 64.2% having two parents who followed higher education. They had between 0 and 3 siblings (M = .84, SD = .79) at the time of the first assessment. Most children attended day care, for an average of 1.85 days per week (SD = .93, range 0–5) at the time of the first assessment. All children were healthy and showed no indications of atypical development. The study was approved by the Ethics Committee of the university's Faculty of Social Sciences. Parents were informed of the topic and procedures of the study and gave informed consent for the participation of their child in the study.

2.2 | Selection of participants

At 28, 36, and 44 months, children were invited to the lab for a play session and paired with an unfamiliar same-sex peer (also from the longitudinal sample), who was different for each play session. The pairing of children was based on their availability to come to the lab and age at day of testing (preferably within two weeks around the target ages of 28, 36, and 44 months). Children who were unable to participate in a play session at 36 or 44 months due to scheduling problems were allowed to continue participation in the study.

At 52 months, sociometric data were collected in the classrooms of the children in the longitudinal sample. As children in the longitudinal sample were born within 4 months from each other, all were tested between April and June, and differences in testing age were small (M = 51.67, SD = 1.17). The 181 children of the longitudinal sample ended up in a diversity of schools at the age of four. Of the 90 different schools in which children were enrolled, 88 agreed to participate. One school could not be included due to scheduling problems, yielding 87 schools with 124 classes. The parents of all children in these classes (target children and classmates) received a letter explaining the study and asking permission for a 5-min sociometric interview with their child at school. Fourteen parents of classmates did not want their child to participate, yielding a sample of 3,104 four- to six-year-old children (51% boys; M = 25 per class, SD = 5). Classes were mixed in age: In The Netherlands children begin school on their fourth birthday and stay in the same class until the summer of the year they turn six.

2.3 | Procedure

The lab play sessions at 28, 36, and 44 months started with 10–30 min of free play during which children could familiarize themselves with each other, the experimenters, and the novel environment. This acquaintance phase was followed by a 5-min cooperation task. Parents were asked to minimize their own interactions with their child during the task. Sessions lasted approximately 45 min. Children received a book or €10 "for their piggy bank" as a thank you for participation. The complete session was unobtrusively videotaped from two angles. One 28-month-old dyad was excluded due to missing video recordings.

For the sociometric assessment at 52 months, children were interviewed individually by a student assistant unfamiliar to the child. This interview took place in a quiet room at school, out of view of their classmates. The interview lasted approximately five minutes and the student assistant was present all the time. Teachers were offered a picture book for their class as a thank you for participation.

2.4 | Cooperation task

The cooperation task was based on Warneken, Chen, and Tomasello's (2006) double-tube task. The setup consisted of two 1-meter tubes mounted in parallel on a box with a 45-degree incline (see Figure 1). The two children were shown a Playmobil figure in a swimsuit and a small swimming pool. They were told that the figure wanted to go through the sliding tube into the pool. The tubes were too long for one child to both hold the pool and insert the figure into the tube at the same time. Therefore, the two children had to cooperate to perform the task. If they stopped playing, children were encouraged to keep sending the figure down the tube. If one of the children did not participate in the cooperation task during the first 2 min or five slides of their play partner, the experimenters performed the task with both children twice. A detailed description of the task can be found in Endedijk et al. (2015). If thereafter one or both children still did not get involved, but stayed close to their parent away from the play material, the task was terminated after three more attempts by one of the dyad partners. Dyads with five or fewer slides of the figure were excluded from the analysis as their cooperation behavior could not be estimated reliably (12 dyads at 28 months, 8 dyads at 36 months, and 5 dyads at 44 months).

FIGURE 1 Children coordinating their actions during the cooperation task

2.5 | Action coordination

Action coordination was coded offline from the video recordings, in line with previous studies (e.g., Brownell & Carriger, 1990). For the cooperation task, the coded actions were children's approaches to the tube with the figure or pool and releases of the figure in the tube. To measure whether children coordinated their actions to their partner, for each child we coded the task actions that came after the partner had chosen one of the tubes with the figure or the pool. An action was coded as *coordinated* if: (1) the child approached the same tube with the figure as the partner held the pool under, (2) the child approached the same tube with the pool as the partner held the figure above, or (3) the child let the figure slide at a moment when the swimming pool was below the tube. An action was coded as *uncoordinated* if: (1 & 2) the child chose a different tube from the partner (with either figure or pool), or (3) the child let the figure slide at a moment when the pool was not below the tube. This last uncoordinated action could be due to sliding the figure through the "wrong" tube or due to sliding the figure at a moment when the partner was not holding the pool below one of the tubes. The recordings of 20% of the dyads at each time point were coded by two observers. Cohen's Kappa was .78 on average (*SD* = .17). An action coordination ratio was calculated that controlled for the total number of actions performed by the child by subtracting the number of uncoordinated actions from the number of coordinated actions and dividing the result by the total number of actions.

2.6 | Interaction quality

For interaction quality, the same video recordings were used as for action coordination. Interaction quality was coded for each child using a scheme based on Hunnius, Bekkering, and Cillessen (2009). Behaviors were coded as *affiliative* or *antagonistic*. Affiliative behaviors were sharing, helping, directing, asking for material/procedure, asking for help, agreeing, and giving a positive response (see Table 1). Antagonistic behaviors were taking away,

TABLE 1 Coding scheme for interaction quality

Affiliative behaviors	
Sharing	Hands over the Playmobil figure/swimming pool to the peer
Helping	Gives task directions, helps the peer with the task, or prepares peer that the figure is going to slide
Directing	Directs the behavior of the peer by assigning a role to the peer
Ask material/procedure	Asks for figure/swimming pool, asks for a turn, or asks what the peer wants
Ask for help	Asks the peer for help
Agree	Agrees verbally to a question of the peer
Positive response	Responds by laughing, applauding or making positive comments to the behavior of the peer or to the successful cooperation
Antagonistic behaviors	
Taking away	Snatches away the figure/swimming pool out the hands of the peer, or aims to do so
Competing	Races against the peer to get the figure or the swimming pool
Claiming/hinder	Claims one of the objects, refuses to share an object (by turning away or hiding the object), hinders the peer to insert the figure into the tube by placing the hands over the tube
Protesting	Protests as a reaction to peer's behavior or question
Aggression	Aggressive acts toward the peer or material (e.g., pushing, throwing the figure on the ground)
Neglecting	Does not respond to approaches (e.g. sharing), directions or a question of the peer

competing, claiming/hindering, protesting, aggression, and neglecting. Repeated occurrence of the same behavior category was coded as a new occurrence if the child had stopped the behavior before showing it again, if it occurred after a new peer-directed behavior of the partner, and in the case of verbal behavior, once for each utterance. The first author trained eight independent coders who were not aware of the children's behavior during peer play at previous time points or their social position at school age. They were monitored regularly, as one in six videos was double-coded by the trainer. Coders had to have more than 70% agreement within a 3-s interval to continue. Two coders who failed this criterion in the beginning received additional training. Cohen's Kappa was .75 on average (*SD* = .07). Based on the coding, again a ratio was calculated by subtracting the number of antagonistic behaviors from the number of affiliative behaviors and dividing the result by the total number of interactive behaviors.

2.7 | Sociometric assessment

Computerized sociometric ratings were used to establish children's peer preference (see Asher, Singleton, Tinsley, & Hymel, 1979; Hymel, 1983). In the current study, a computerized version of this procedure was used, that has several advantages over the original offline procedure with respect to organization, data collection and data processing (Endedijk & Cillessen, 2015). Based on digital photographs of classmates, each child rated all classmates on a 3-point scale: “Do you like to play with X (child's name), do you not like to play with X, or do you sometimes like and sometimes not like to play with X?” Children rated each classmate by clicking on a corresponding emoticon (happy for “like,” neutral for “sometimes like and sometimes not like,” and sad for “do not like”). Classmates were presented in random order. The session started with two practice trials that featured a picture of a ball and a toy train. One school had the policy not to work with computers in the classroom. For this class, pictures were printed

and sorted into plastic boxes with the emoticons on them. Earlier research has shown no differences in results obtained via this procedure and the computerized procedure (Endedijk & Cillessen, 2015).

From the raw numbers of liked, disliked, and neutral choices received, children's social preference was calculated following Coie, Dodge, and Coppotelli (1982), which is suitable for ratings (Maassen, Akkermans, & van der Linden, 1996). The percentages of liked and disliked choices were transformed into *z*-scores within classes to control for differences in class size. Social preference was computed as the difference between the standardized liked and disliked scores, and again standardized within classes.

2.8 | Missing data and outliers

Children could only receive scores for interaction quality and action coordination when both dyad members were involved in the cooperation task (independent of the success of the cooperation). However, sometimes children did not want to play but stayed close to their parents, which led to 19% missing data and 47% of the participants missing data for at least one time point. Children with missing data at any time point showed lower interaction quality at the age of 28 months, $F(1, 151) = 5.732$, $p = .018$, $r = .19$, but higher preference by peers at 52 months, $F(1, 164) = 4.98$, $p = .027$, $r = .17$, than children with data for all variables at all assessment times.

Outliers were not excluded as they represented true observations and to keep the data set as complete as possible. To make sure that possible outliers did not bias the results, the analyses also were run after having removed values that differed more than two standard deviations from the mean, and the pattern of results was the same but with stronger effects.

3 | RESULTS

3.1 | Preliminary analyses

Table 2 shows the ratios of action coordination and interaction quality for boys and girls. Interaction quality was significantly different for boys and girls only at 28 months, with girls showing higher levels of interaction quality than boys, that is, relatively more affiliative behaviors than antagonistic behaviors. There were significant developmental changes in action coordination, $F(2, 443) = 116.23$, $p < .001$, $r = .46$, and interaction quality, $F(2,$

TABLE 2 Ratio of coordinated to uncoordinated actions and ratio of affiliative to antagonistic behaviors at 28, 36, and 44 months by gender

	Boys			Girls			Comparison			
	n	*M*	*SD*	*n*	*M*	*SD*	*df*	*F*	*p*	*r*
Action coordination										
28 months	68	−.41	.61	72	−.45	.63	1, 138	.18	.674	.04
36 months	70	.36	.38	77	.35	.48	1, 145	.04	.852	.02
44 months	65	.38	.42	84	.34	.46	1, 147	.28	.600	.04
Interaction quality										
28 months	76	−.32	.56	77	−.09	.63	1, 151	5.93	.016	.19
36 months	68	.19	.56	77	.25	.53	1, 143	.46	.498	.06
44 months	64	.30	.51	80	.40	.52	1, 142	1.22	.271	.09

439) = 40.44, $p < .001$, $r = .29$. In general, children showed higher levels of action coordination and interaction quality with age, with significant differences between 28 and 36 months and between 28 and 44 months (all ps < .001), but not between 36 and 44 months, both for action coordination ($p = 1.000$) and interaction quality ($p = .119$). This pattern of findings indicates that children developed rapidly in their interaction skills during early childhood, mainly between two and three years of age. Moreover, although girls showed higher levels of interaction quality than boys at 2 years of age, this was not evident from 3 years onward.

As children performed the task in dyads, we examined the degree to which their behavior was interrelated by means of intra-class correlations (ICCs). The ICCs indicated high dyadic dependence for the ratios of coordinated to uncoordinated actions and affiliative to antagonistic behaviors in almost all cases (see Table 3). Only action coordination of boys and girls at 36 months and of boys at 44 months, and interaction quality of boys at 36 months were not significantly dependent between interaction partners. Fisher's r-to-Z transformations were used to compare the ICCs by gender (Donner & Zou, 2002). At 44 months, action coordination was more interdependent for girls than boys ($Z = -3.22$, $p = .001$). These findings show that in general children's social behavior, both the interaction quality and their action coordination, was highly dependent on their play partner.

Correlations between the ratios of coordinated to uncoordinated actions and antagonistic to affiliative behaviors were computed to verify that they measured different constructs (see Table 4). Action coordination and interaction quality were correlated moderately and positively for boys at 28 months and for girls at 36 and 44 months. Fisher's r-to-Z transformation revealed marginally significant gender differences in these correlations, with a stronger positive relation for boys at 28 months, and a more positive relation for girls at 36 and 44 months (28 months: $Z = 1.95$, $p = .051$; 36 months: $Z = -1.77$, $p = .077$; 44 months: $Z = -1.73$, $p = .084$). These results suggest that there was no collinearity between action coordination and interaction quality for boys or girls. Therefore, the effects of interaction quality and action coordination for peer evaluation can be estimated reliably.

Observed behaviors were not significantly correlated across ages, indicating little stability (Table 4). Only boys' action coordination at 44 months was related positively to their action coordination at 36 months, but negatively to their action coordination at 28 months. Girls' interaction quality at 28 months was related marginally and negatively to their interaction quality at 36 months. Comparison of this correlation for girls with the correlation of interaction quality for boys between 28 months and 36 months showed marginally significant gender differences ($Z = 1.85$, $p = .064$). This result indicates that children's action coordination and the quality of their interactions were unstable over time, especially between the ages of 2 and 3.

TABLE 3 Intra-class correlations (ICCs) for action coordination and interaction quality at 28, 36, and 44 months by gender

	Boys		Girls		Comparison	
	ICC	*p*	*ICC*	*p*	*Z*	*p*
Action coordination						
28 months	.64	.004	.68	.001	−.26	.795
36 months	.13	.342	.29	.151	−.68	.497
44 months	−.31	.771	.44	.034	−3.22	.001
Interaction quality						
28 months	.68	<.001	.67	<.001	.03	.976
36 months	.33	.135	.63	.001	−1.65	.099
44 months	.58	.009	.56	.007	.16	.873

Note: Boys: $Ndyads_{28months} = 38$; $Ndyads_{36months} = 35$; $Ndyads_{44months} = 33$. Girls: $Ndyads_{28months} = 39$; $Ndyads_{36months} = 39$; $Ndyads_{44months} = 42$.

TABLE 4 Correlations between measures of action coordination and interaction quality at 28, 36, and 44 months by gender

	Action coordination			Interaction quality		
	28 months	36 months	44 months	28 months	36 months	44 months
Action coordination						
28 months		−.01	−.20	.09	.22***	.15
36 months	.09		.01		.34**	−.10
44 months	−.34*	.29*				.28*
Interaction quality						
28 months	.41**				−.24***	−.09
36 months	.10	.05		.10		.09
44 months	−.20	.04	−.01	−.12	−.01	

Note: Correlations above the diagonal for girls, below the diagonal for boys.
*$p < .05$; **$p < .01$; ***$p < .10$.

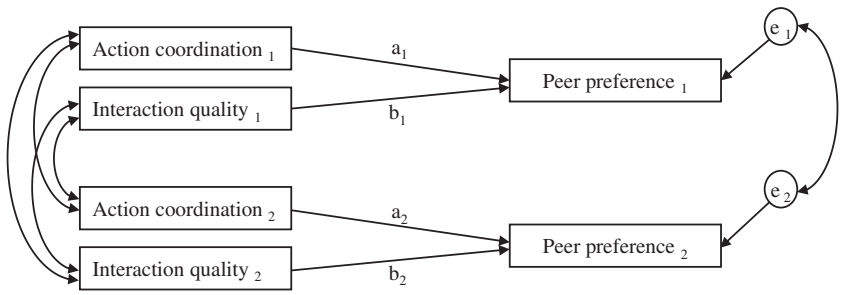

FIGURE 2 Dyadic model to estimate the relations of action coordination and interaction quality during cooperation with a peer and later peer preference. The subscripts refer to the first and second child in the dyad, respectively. Because dyads were indistinguishable (Kenny et al., 2006), paths were set equal between dyad members

3.2 | Relation between peer cooperation and peer preference

To estimate the predictive value of children's peer cooperation for their later peer evaluations, dyadic analyses were conducted with structural equation modeling in Amos 20.0 (IBM SPSS, Armonk, USA). We used a simplified Actor-Partner Interdependence Model (APIM; Kashy & Kenny, 2000), in which we estimated the regression paths of both play partners at the same time, while taking into account the correlation between their behaviors (see Figure 2). Means, variances, covariances, and paths were set equal between dyad members, because the two children in each dyad were indistinguishable (Kenny, Kashy, & Cook, 2006). As children had a different play partner in each assessment, a separate model was run for each assessment time. The model was run as a two-group multigroup analysis to examine differences between boys and girls.

There were no significant relations between action coordination at 28, 36, or 44 months and peer preference at 52 months. There were significant relations between early interaction quality and later peer preference. Interaction quality at 28 and 44 months predicted peer preference at 52 months for girls (see Table 5, unconstrained model). Girls with higher dyadic interaction quality (more affiliative behaviors and fewer antagonistic behaviors) with a peer in early childhood were more preferred by their first classmates later. There were no significant relations between early peer interaction quality and later peer preference for boys.

Although the multi-group model suggested gender differences, a comparison of models revealed that model fit was not significantly different when all paths were constrained to be equal for boys and girls compared to a model

TABLE 5 Standardized estimates for the prediction of peer preference at 52 months from interaction quality and action coordination at 28, 36, and 44 months in an unconstrained model and a model constrained by gender

	Gender	28 months	36 months	44 months
Unconstrained model				
Action coordination	Girls	.07	−.01	−.15
	Boys	−.07	.01	−.09
Interaction quality	Girls	.24*	.03	.29*
	Boys	.10	.07	.04
Constrained model				
Action coordination		.00	−.01	−.11
Interaction quality		.16***	.04	.17*

*$p < .05$; ***$p < .10$.

in which all paths were estimated freely for boys and girls (all *p*s > .05). The pattern of results for the constrained model was similar to the results for girls reported above, with a significant effect of the ratio between affiliative and antagonistic behaviors at 44 months on peer preference, and a marginally significant effect at 28 months ($p = .059$) (see Table 5, constrained model). Thus, children's interaction quality during toddlerhood was related to their preference by peers at 4 years of age, and this effect appeared to be mainly there for girls.

4 | DISCUSSION

In this study, we investigated the relation between peer cooperation in toddlerhood and later preference by peers. Children's ability to coordinate actions and show good interaction quality during peer play were assessed longitudinally at ages 28, 36, and 44 months. After the transition to school, children's preference among their new classroom peers was examined at 52 months of age. Results revealed that children, especially girls, who showed more affiliative and fewer antagonistic behaviors during toddlerhood were more preferred at 4 years of age by their peers in school. These results are consistent with earlier findings of an association between peer interaction quality and peer evaluation in (pre)school-age children (e.g., Rubin, Daniels-Beirness, & Hayvren, 1982; Sette et al., 2013; Vaughn et al., 2003). Importantly, the results showed that children's peer preference in their new classrooms can be predicted from early peer interactions in toddlerhood.

4.1 | Action coordination

Our study was novel in examining whether there was a long-term relation between action coordination and peer preference after the transition into newly structured social groups when children go to school for the first time. Contrary to our expectations, we found no evidence for a predictive relation between action coordination and later preference by peers. Previous experiments suggested a positive association between proficient action coordination and social evaluation directly after a task (Demos et al., 2012; Hove & Risen, 2009; Lakens & Stel, 2011; Plötner et al., 2015; Tunçgenç, Cohen, & Fawcett, 2015). It is possible that successful action coordination determines immediate social evaluation when it is the only information available about the interaction partner, which was the case in previous experimental studies of the effect of action coordination on social evaluation, but becomes less influential when other social skills can be considered as well. Based on a series of action coordination studies on children's implicit copying behaviors, van Schaik (2017) also concluded that during live interactions other behaviors in addition to action coordination might contribute more to social evaluation.

4.2 | Interaction quality

More affiliative behaviors and fewer antagonistic behaviors were related to peer preference, consistent with a large body of work on the associations between social behavior and peer preference in early childhood (e.g., Santos et al., 2013; Sette et al., 2013; Vaughn et al., 2003; Walker, 2009). Our study added to this literature by confirming the predictive value of interaction quality in children's earliest dyadic peer interactions for their social preference later at school. Our findings suggest that differences in children's social competence to establish likeability in a novel peer group during the first few months after starting school are present in and formed by their very first dyadic interactions with peers as toddlers.

4.3 | Gender differences

Although the overall model did not differ by gender, the estimates by gender strongly suggest that the significant result was driven by the significant positive relation between interaction quality and peer preference for girls, but not for boys. This result is in accordance with findings at later ages when high levels of prosocial behavior and low levels of antisocial behavior predict better peer acceptance for girls but not boys (Oberle, Schonert-Reichl, & Thomson, 2010). As such, it suggests gender differences in the behaviors important for positive peer evaluations. In early childhood, boys and girls prefer play activities that require different skills (Fabes et al., 2004). Boys' early play behavior tends to be more physical and competitive; girls tend to be more verbal and cooperative in their play (Maccoby, 1990, 2002). We did not code competitive behavior, such as the speed with which a child grasped a toy before the other child did, or whether a child switched a toy quickly between the tubes in order to make it harder for the peer to coordinate. Further, girls frequently play in dyads whereas boys tend to play in larger groups (Benenson, Apostoleris, & Parnass, 1997). As such, the context in which we assessed peer interaction as well as the behaviors we measured may have been geared more toward the typical play situations of girls. Boys' group play may require different interaction skills. Indeed, van den Berg, Deutz, Smeekens, and Cillessen (2017) found that 5-year-old boys who were less able to inhibit impulsive behaviors were more popular among classmates 4 years later whereas girls with the same behaviors were less popular. Oberle et al. (2010) found that for adolescent boys higher positive affect, lower empathy, and lower anxiety predicted higher peer preference whereas girls lower positive affect and higher empathy predicted higher peer preference. Examining in more detail the possible working mechanism is an important avenue for future research. Our results also showed high within-gender variability in interaction quality. To better understand the relation between early peer interaction quality and later preference by peers, future studies should consider a broader range of interactive behaviors and play situations that require diverse social skills. A study that includes both a variety of behaviors and play situations will shed further light on the possible sources of gender differences in peer play and peer evaluations among young children.

4.4 | Peer evaluations

The predictive value of interaction quality for later preference by peers was already evident at 2 years of age. Girls who showed more affiliative and fewer antagonistic behaviors at the age of two were evaluated more positively by classmates at 52 months. This predictive pattern was the same at 44 months, but was not found at 36 months. Friedlmeier (2009) also reported an inconsistent predictive pattern of interaction quality for later peer status: Although interaction quality in 11–20-month-old infants predicted their peer status in kindergarten and first grade, this was not found for 30–42-month-old children. Besides a power problem, a combination of several processes could explain these inconsistent results. It could be that children differ from early on in their

prosociality (Jensen, Vaish, & Schmidt, 2014; Tomasello & Vaish, 2013; Warneken, 2015), but that good interaction quality looks different across the early ages. This is consistent with the adaptive function of antagonistic behavior in early childhood, as until the age of three it is part of social exploration by which young children discover how to interact with others (Vaughn et al., 2003). In later childhood, antagonistic behavior is evaluated mainly negatively by peers (Dodge et al., 2006), although several studies have found that antagonistic behaviors are maladaptive also in early childhood (Hart, DeWolf, Wozniak, & Burts, 1992; NICHD Early Child Care Research Network, 2004). Moreover, within the range of antagonistic behaviors, children develop a set of diverse peer interaction skills at different ages, based on their learning from experience as well as maturation (Brownell, 2016; Hay, Castle, Davies, Demetriou, & Simson, 1999). Some antagonistic behaviors may be adaptive or maladaptive at each age, such as aggression whereas others may be appropriate at certain ages only, such as claiming toys or teasing another child by competing for a toy. This is consistent with our finding that children's interaction quality was unstable over time, especially between the ages of two and three. What exactly defines high interaction quality during early development requires further study in order to clarify the predictive value of several affiliative and antagonistic behaviors at different ages for children's later social development.

4.5 | Dyadic dependency

An interesting finding of our study was that action coordination and interaction quality were highly correlated between play partners. This suggests that young children's dyadic play behavior depended on with whom they played. This may reflect the reciprocity of social interaction. As an illustration, Warneken and Tomasello (2013) showed that one child's sharing led to more sharing of another child already in 3-year olds, indicating reciprocity of prosocial behavior. Our findings suggest similar dynamics for action coordination. The cooperation patterns of our dyads were marked by behavioral reciprocity and less by individual tendencies. Because children's cooperation is important for their social as well as academic development, it is worthwhile to further study reciprocity in children's interaction quality and action coordination.

Further, flexible adaptation to a partner or social situation may be an indicator of social competence (e.g., Friedlmeier, 2009). Indeed, Stolk, Hunnius, Bekkering, and Toni (2013) studied how 5-year-old children adapted their behavior when they believed that they were playing a game with a toddler instead of a same-age peer and found that adaptive competence was larger for children who had spent more time in daycare. This study suggests that adaptation to a play partner and play situation is a building block for successful peer interaction. How children's flexibility and behavioral adaptation to different peers is related to their later social status is an important topic for future research.

4.6 | Limitations

This study had some limitations. Firstly, we used dyadic analyses because children were nested in dyads and there was, as usual, interdependence of behavior within dyads. Because the dyads were composed differently over time (a different unfamiliar peer at each time point), we could not analyze the data longitudinally. In order to take into account the dyadic dependency and analyze within-person development over age, a larger design is needed in which children participate in the cooperation task with more than one partner at each wave, and with the same partners over time. In the current project, we did not have the resources for such an extended design. The current study involved 270 dyadic sessions over three years, plus individual sociometric assessment with more than 3,000 children, forming already an extensive project. A larger study in the future will need substantial resources. For the current study, given the current sample size, the results should be interpreted with some caution and replication of our findings is recommended.

4.7 | Conclusion

In summary, this study adds to our knowledge of the early determinants of later preference by peers. By following children longitudinally from toddlerhood until they made the transition to a new social group at school, we found a relation between interaction quality and peer preference, but no indication of a predictive relation between successful action coordination and later preference by peers. Results showed that children, especially girls, who showed more affiliative and fewer antagonistic behaviors during peer cooperation were better liked by their peers later in school, and this was already evident at the age of two. These results suggest that individual differences in peer interaction quality in toddlerhood are among the earliest roots of how well-liked children are by peers when they start going to school.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author.

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