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Does popularity determine who leads in a dyadic cooperative task? Subtle differences between children with and without developmental disabilities

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ABSTRACT

Background: Popular indivuals are usually academically high achieving and also often leaders. Children with developmental disabilities are usually not popular among their peers. In dyadic cooperative tasks, the popular member is often the leader, as shown by self-reports and observational research. It is unknown whether this macro-level behaviour is reflected in micro-level synchronisation patterns of the movements of dyads who are engaged in a cooperative task.

Aims: The goal of the present study was to investigate whether popularity differentially affected the leading-following behaviour of dyads consisting of children with and without developmental disabilities.

Methods and Procedures: Children with ($n = 106$) and without ($n = 183$) developmental disabilities performed a tangram puzzle task individually and cooperatively. While performing the task, they stood on a Nintendo Wii Balance Board that registered their postural sway.

Outcomes and Results: Although we found some similarities between dyads with and without a developmental disability based on both popularity and task performance, the most striking difference occurred in low performing dyads. In those, dyads with a developmental disability had no clear leader or follower.

Conclusion: Especially in dyads with developmental disabilities it is important that there are clear roles, since the worst performance was observed when roles were absent.

What this paper adds?

Leader-follower behavior in a dyad during a cooperative task can be assessed by looking at the pattern of movement synchronization (postural sway) between the two dyad members.

High-achieving dyads with and without developmental disabilities appeared to benefit from a less popular leader, whereas average-achieving dyads benefitted from a popular leader.

Low-achieving dyads with developmental disabilities suffered from the absence of a clear leader.

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1. Introduction

Jointly working on a task to reach a common goal is usually more effective than working alone (e.g., Johnson & Johnson, 1999; Roseth, Johnson, & Johnson, 2008). Ample research has revealed the positive effect of cooperative learning on academic achievement, particularly in children who are paired with a peer of relatively higher academic ability (e.g., Garton & Pratt, 2001). The interactions that takes place while working together may, as a result of opposing viewpoints and in terms of Piaget (1959), yield a cognitive conflict or state of disequilibrium between the cooperating partners. Conflicting opinions require rethinking one's ideas and discussing the information presented by the cooperating partner, which in turn may lead to regaining equilibrium with cognitive growth as a result (Fawcett & Garton, 2005). Interestingly, cooperating on a task may also enhance social outcomes. Positive interdependence, when partners in a cooperative task encourage one another to maximize their efforts to obtain their common goal, is usually promotive and strengthens prosocial behaviour (Choi, Johnson, & Johnson, 2011).

Although cooperative achievement is to a large extent determined by the cognitive abilities of the cooperating partners, research clearly has shown that social factors also greatly affect the outcome in a cooperative task. One such factor is sociometric status. Sociometric status broadly refers to the degree to which an individual is liked or accepted by peers. The literature usually recognizes five categories: accepted, rejected, neglected, controversial, and average children (e.g., Coie, Dodge, & Coppotelli, 1982). A robust finding is that popular children tend to be more cooperative than unpopular children (de Bruyn & van den Boom, 2005; Puckett, Aikins, & Cillessen, 2008). In the literature on social development, two types of correlated but distinct constructs of popularity have been distinguished, namely *sociometric popularity* and *perceived popularity* (LaFontana & Cillessen, 1999; Parkhurst & Hopmeyer, 1998). Sociometric popularity refers to likeability or social acceptance and is derived from children's or adolescents' nominations of peers they like most and like least. Perceived popularity, a measure of power, visibility, or status in the peer group, is derived from youths' nominations of peers as most popular and least popular (i.e., reputation; Lease, Kennedy, & Axelrod, 2002). The main goal of the present study was to examine the role of social status in dyadic interactions during a cooperative learning task. In doing so, we focused on the construct of perceived popularity.

Perceived popularity (referred to here as *popularity*) is correlated with both positive and negative traits or behaviours. On the positive side, popularity is related to, among other things, cooperation (Puckett et al., 2008), being athletic, cool, and tough, having good social and interpersonal skills, and being physically attractive (Adler & Adler, 1998). On the negative side, popularity is associated with social dominance (Lease et al., 2002), aggression, and risk behaviours (Cillessen & Mayeux, 2004; Sandstrom & Cillessen, 2006). Moreover, adolescents who are popular and aggressive devalued academic achievement and disengaged from school (Schwartz, Nakamoto, Hopmeyer Gorman, & McKay, 2006).

1.1. Popularity and developmental disabilities

Although most studies on popularity have been conducted with children and adolescents without psychiatric disorders, several studies have examined the sociometric status of children and adolescents with developmental disabilities. A general and fairly consistent picture is that the sociometric status of children and adolescents with developmental disabilities is generally less favourable than that of their peers without disabilities. Parker, Rubin, Erath, Wojslawowicz, and Buskirk (2006) discussed, in their overview on peer relationships and psychopathology, the lower sociometric status of children with a psychiatric disorder, such as ADHD, Conduct Disorder, Autism Spectrum Disorder, Anxiety Disorder, or Depression and Loneliness. The group with developmental disabilities is greatly underrepresented in the accepted category, overrepresented in the rejected group and they are often disliked by their peers without disabilities.

Not only children with psychiatric disorders are being judged as less popular by their peers, children with learning disabilities (not discussed in Parker et al., 2006) also run that risk (see, for reviews, Nowicki, 2003; Ochoa & Olivarez, 1995; Ruijs & Peetsma, 2009). Although children with psychiatric disorders may also (and often) have learning disabilities, which as such may affect their popularity, the group with only learning disabilities constitutes a distinct category. Their sociometric status is to some extent dependend on the school context. In an inclusive educational context, children with learning disabilities are usually less well-accepted, have a lower self-image, and a lower social status than children without learning disabilities (Bakker & Bosman, 2003; Bakker, Denessen, Bosman, Krijger, & Bouts, 2007; Bursuck, 1989; Nowicki, 2003; but see Sabornie, Kauffman, & Cullinan, 1990). Interestingly, in the Dutch context, there appears to be an distinction between the sociometric status of children who attend inclusive education and those who attend exclusive education. Bakker and Bosman (2003); see also Bakker et al., 2007) showed that Dutch children with learning disabilities in special or exclusive education had a much more favourable status than their learning-disabled peers in regular or inclusive education.

1.2. Popularity and leadership

Socially accepted children are often influential, admired, and possess leadership skills. Popularity is also correlated with leadership and this association is stronger than for socially accepted children (Lease et al., 2002; Puckett et al., 2008). Influential adolescents (13–15 years old) described themselves as being more popular and possessing stronger leadership abilities than less influential peers (Loke, Mak, & Wu, 2017). Influential adolescents believe that it is their considerateness of others that made them popular among peers. In addition, they have communicative abilities that enable them to initiate a dialogue with a peer and, as a result, make it possible for their peers to voice their feelings or thoughts. Influential peers may be leaders due to their popularity, since others often follow the behaviour of popular or influential peers. Indeed, as Lease et al. (2002) showed, children prefer a

popular group leader.

Students in higher education who are considered leaders obtained higher average final grades, higher peer evaluations for 'team citizenship', and higher social self-efficacy scores than followers (Dingel & Wei, 2014; Dunbar, Dingel, Dame, Winchip, & Petzold, 2016). Being a leader appears to have benefits. However, there is one caveat regarding cause and effect. Does one become a leader as a result of being an academically high-achieving student or is being a leader a motivation for a student to study hard?

The empirical studies on the association between leading in an interaction and popularity were obtained with peer nominations and teacher ratings, that is, macro-level information based on self- or other reports. Although highly valuable, they do not provide us with lower-level or micro-analytical information concerning behavioural mechanisms. Micro-analytic methods may reveal behavioural patterns that individuals are not consciously aware of, but may reveal important characteristics of socially competent behaviour. One way to examine behaviour at a micro level is by studying synchronised temporal movements in dyadic interactions. Synchronisation or coordination measures in the movement behaviour of two interacting individuals provides us with information that is invisible for the researcher without tracing the movements of the dyad at a millisecond level and over an extensive period of time (20–30 minutes) and these patterns appear to go unnoticed by the participants (e.g., Abney, Paxton, Dale, & Kello, 2015; Louwerse, Dale, Bard, & Jeuniaux, 2012).

1.3. Rhythmical coordination, social acceptance, and academic achievement

Coordination or synchronization regards the form and timing of behaviours or movements. Coordination takes place when a specific action (e.g., lifting a table) is performed by two persons at the same time, but how it is done may differ (e.g., one person may lift the table in front of her, while the other lifts it behind her back). Synchronization means doing the same thing at (about) the same time, such as walking down the street at stride-intervals that are synchronized. Louwerse et al. (2012) described this distinction in detail.

Numerous studies have investigated how dyadic synchronization is related to social factors. In a recent meta-analysis on the outcomes of interpersonal coordination, Vicaria and Dickens (2016) stated that "At the dyad or group level, interpersonal coordination consistently increases harmonious feelings among interacting partners, and generally promotes prosocial behaviours. … Therefore, interpersonal coordination is indeed the "social glue" that promotes social cohesion among interacting partners" (p. 19). Increased feelings of closeness and similarity, liking, trust, cooperativeness, helping behaviour, and compliance were significantly related to interpersonal coordination. Measures of popularity, power or dominance, were not included in their meta-analysis, but Dunbar and Mejia (2012) showed that power also affects synchrony. Interactions of equal-power couples were more synchronous overall, whereas interactions of unequal-power couples were more asynchronous. This finding can be related to popularity, since popular youths generally are seen as powerful and dominant (Cillessen & Rose, 2005).

Vink, Hasselman, Cillessen, Wijnants and Bosman (2018) examined leading and following at a micro-level in the postural sway patterns of cooperating dyads. They examined whether postural sway in cooperating dyads depended on the performance of the dyad and the developmental level of the dyad members. In dyads without developmental disabilities consisting of children attending regular education, the more competent dyad member (as indicated by an individual pretest score) was in the lead, while the less competent dyad member followed, and this was not influenced by dyadic performance. In dyads of children with a developmental disability, who attended special education, low-performing dyads needed a competent child in the lead, whereas relatively well-performing dyads benefitted from a less competent child in the lead. In other words, these dyads benefitted from a more skilled *follower*. In another study, dyads of children with and without developmental disabilities did not differ on aggregated measures of synchrony and coordination of postural sway (Vink, Hasselman, Wijnants, Cillessen and Bosman, 2019). Studying dyads with micro-analytic measures may thus provide insight in children's social behaviour that cannot be obtained from general measures.

1.4. Popularity, leading-following behaviour, and developmental disabilities

As shown, popularity is positively related to academic performance and popular children are usually leaders. Thus, a popular member in a dyad engaged in a cooperative task is probably the leader. Although this is generally the case when we approach this question at a macro level, it is unknown whether the behavioural micro-interactions also reveal this pattern for both children with and without developmental disabilities. This is all the more interesting considering the fact that children with developmental disabilities who performed well were better off with a more skilled follower, which was not the case for children without developmental disabilities.

Thus, the goal of the present study was to investigate whether popularity differentially affected the leading-following behaviour of dyads of children with developmental disabilities and dyads of children without developmental disabilities. As indicated, children with developmental disabilities are usually less popular than children without developmental disabilities. However, in the Dutch educational context, there is still a large group of children with developmental disabilities who attend special education; they do not participate in regular mainstream education. This provides us with a unique opportunity to assess the effect of popularity in two groups of children who are educated in different contexts. In both contexts, social status is determined by peers with similar backgrounds. It may well be that social status, determined relative to the peer group, leads to similar micro-level interactions, that is similar leading-following behaviour based on popularity.

2. Method

2.1. Participants and procedure

The methods of this study were similar to those of Vink, Wijnants, Bosman and Cillessen (2017) and Vink et al., 2018; Vink et al. (2018, 2019). Participants were children with and without developmental disabilities (taken from the Vink et al. studies). The sample of children without developmental disabilities consisted of 183 dyads of children attending regular primary education (M_{age} = 10;8 years, SD = 1;00, range 8–13; 95 boys, 88 girls). The sample of children with disabilities consisted of 106 dyads of children attending special primary education (M_{age} = 10;10, SD = 1;3, range 8–13; 74 boys, 32 girls). Inclusive education is (not yet) fully implemented in the Netherlands. As a result, a large group of children with special needs is referred to special primary education. They do not necessarily have an official DSM diagnosis (although many of them do), but all of them show behavior that is reminiscent of a developmental disorder, such as ADHD, PDD-NOS, dyslexia, or autism. Due to the large diversity within this group, it is difficult to draw conclusions about each of the disorders that are present. In addition, privacy legislation prevented schools from sharing details about the specific disabilities of the children. Therefore, we chose to look at this group as a whole, as a group of children with a developmental disorder (i.e., the commonality) and how this group (as a whole) differs from its typically developing counterpart.

Children were randomly assigned to a dyad with a same-sex classmate, because gender composition also affects the effectiveness of cooperative learning. Same-gender dyads generally outperform individuals working on a task, whereas different-gender dyads do not (Underwood, McCaffrey, & Underwood, 1990).

Not all participating dyads were included in the current analyses. Reasons for exclusion were technical failures with data recording or an uneven number of children in a classroom, as a result of which one child participated in two dyads or a mixed-sex dyad. In total, 13 regular education dyads and 15 special education dyads were excluded.

Letters were sent to a large number of Dutch regular and special primary schools to request participation. After approximately two weeks, schools were contacted to inquire whether or not they wanted to participate. Additional information was sent via email to the schools that wanted to participate, including a letter for parents with information about the study. Teachers provided the researchers with the names of the children whose parents gave passive consent for participation.

2.2. Measures

Demographics. The questionnaire began with demographic questions. Participating children were asked to indicate their gender, birth date, parents' nationality, and language(s) spoken at home.

Sociometric measures. The questionnaire included standard sociometric questions for likeability ("Who do you like most/least?") and popularity ("Who is most/least popular?"). Children received a roster with the names of their classmates preceded by a code number. Instructions were provided by the researcher. Unlimited nominations were used; children could name as many or as few peers as they wanted for each question. Self-nominations were not allowed. When nominating peers, children used the code numbers, not the names. After finishing the questionnaire, the children could either color a drawing on the back or work on something else.

The sociometric data were processed with SocStat (Thissen-Pennings & Bendermacher, 2002). SocStat counts the number of nominations received by each child for each item. This number is then standardized to z-scores within each classroom. A score for social preference is computed as the difference between the standardized numbers of liked most and liked least nominations received, again standardizing the resulting difference score within classrooms. A score for popularity is computed as the difference between the standardized numbers of most popular and least popular nominations received, again standardizing the resulting difference score within classrooms (Mayeux, Houser, & Dyches, 2011).

Nintendo Wii Balance Boards. To record postural sway of both dyad members, two Nintendo Wii Balance Boards (WBBs; Nintendo, Kyoto, Japan) were used. Clark et al. (2010) and Clark, McGough, and Paterson (2011) showed that the WBB is a reliable, easily moveable, and inexpensive alternative to the less portable and more expensive force platforms often used in clinical settings. For the present study, customized software was used to record both WBBs simultaneously (Voogt, TSG-FSW, Radboud University, the Netherlands). The sampling rate was set at 100 Hz and the collected data provided information about postural sway in both the medial-lateral (X-axis) and anterior-posterior (Y-axis) direction.

Tangram task. A tangram puzzle consists of seven pieces: two large triangles, one medium triangle, two small triangles, a square and a rhomboid (Fig. 1). These pieces can be used to form numerous figures. We used three sets of tangram puzzles (A, B, C). Sets A and C were used for the individual tasks (interchanged between the dyad members across the pre- and posttest). Set B was used for the cooperative task. The figures to be created were printed on A4 paper, on which the children had to lay the tangram pieces to recreate the printed figure.

The experiment that consisted of three parts took place in a quiet room at the school. Each dyad was invited into the room and received an explanation about solving a trangram puzzle. They were told that this was not a competition and asked to perform to the best of their ability.

In Part 1, both children were asked to step on one of the two Nintendo Wii Balance Boards that were placed approximately 70 cm from one another. Each child received their own set of tangram puzzles. They were told that they had 10 min to recreate as many tangram puzzles as possible. During these 10 min, they had to stay on the WBB. When a child finished a puzzle, the researcher checked if it was correct. If so, the child could continue to the next puzzle, otherwise (s)he had to keep trying. Only when children had made many unsuccessful attempts or became very frustrated they were allowed to skip a puzzle. After 10 min, the researcher

Fig. 1. Example of a tangram puzzle.

prompted the children to stop and step off the WBB. The number of puzzles correctly recreated was the pretest score.

In Part 2, the researcher placed the WBBs closer to each other, approximately 10 cm apart. Again, the children were asked to step on the WBB. For this part of the experiment, the children were given only one set of puzzle pieces and one set of tangram figures (set B). The task was identical to the first task, with the only difference that children were allowed to cooperate. The number of puzzles correctly recreated as a dyad was the cooperation score.

Part 3 was identical to Part 1. Children again performed the task individually. The number of puzzles correctly recreated was the posttest score. After Part 3, children received a small gift (e.g., pen or pencil) to thank them for their participation.

2.3. Data preparation and analysis

Cross Recurrence Quantification Analysis. First, the original data, samples at 100 Hz, were down sampled to 5 Hz, since the computer available to analyze the data had insufficient available memory for the 100 Hz data. This resulted in time series of approximately 3000 data points per dyad. Displacement scores (Displ) were calculated as follows:

$$\text{Displ}_t = \sqrt{(X_{(t+1)} - X_t)^2 + (Y_{t+1} - Y_t)^2} \tag{1}$$

where X represents the raw medial-lateral measure and Y the anterior-posterior measure of postural sway.

Cross Recurrence Quantification analyses (CRQA) were conducted on the Displ data in Matlab® (Mathworks Inc., 2012) with the Cross Recurrence Plot (CRP) Toolbox (http://tocsy.pik-potsdam.de; Marwan, Romana, Thiel, & Kurths, 2007). The shared phase space of the dyadic time series was reconstructed using the method of time-delayed embedding (Takens, 1981). To determine an appropriate delay, Average Mutual Information (AMI) was calculated over increasing time lags. The time lag where the first local minimum appeared (the point where the time series reveal an optimum amount of unique information) was chosen for the reconstruction (5 data points). Next, the embedding dimension (7) was determined by a first local minimum of False Nearest Neighbors (FNN; cf. Riley, Balasubramaniam, & Turvey, 1999). The radius (the area in the shared phase space where revisiting trajectories are considered recurrent) was allowed to vary within each dyad, so that the recurrence rate within each dyad was exactly 5% (cf. Wijnants, Bosman, Hasselman, Cox, & Van Orden, 2009). These parameters were used to optimize the reconstruction. However, as Riley et al. (1999) stated, for recurrence analyses on postural sway data, the choices for time lag and embedding dimension are not crucial.

Descriptive Analysis of Leading-Following Behavior in Postural Sway. From the CRQA analyses we extracted for each dyad the diagonal-wise recurrence rate (see Coco & Dale, 2014, for details). For each dyad, a diagonal recurrence profile was obtained within a window of 200 samples (i.e., 40 s, 5 Hz). According to Paxton and Dale (2017), a DRP indicates "how much coordination occurs within a "window" of relative time between participants" (p. 6). That is, "the DRP allows us to explore similarities in patterns of movement that are independent of *absolute* time while revealing patterns of *relative* time" (Paxton & Dale, 2017, p. 6). In short, a DRP can tell us something about leading and following behavior.

To make all DRPs comparable, we placed the dyad member with the best pretest score on the left side of the plot and the other dyad member on the right. DRPs can then be interpreted as follows (see also Fig. 2): If the recurrence peak was left of the middle, the worse performing dyad member was in the lead and the better performing dyad member followed. If the recurrence peak was right of the middle, the better performing member was in the lead and the worse performing dyad member followed. The distance from the middle to the peak indicated the time lag between the recurrent behavior: the larger the distance, the longer it took for the follower to follow the leader's movement. When the peak is approximately in the middle, behavior is near-synchronized, indicating that each
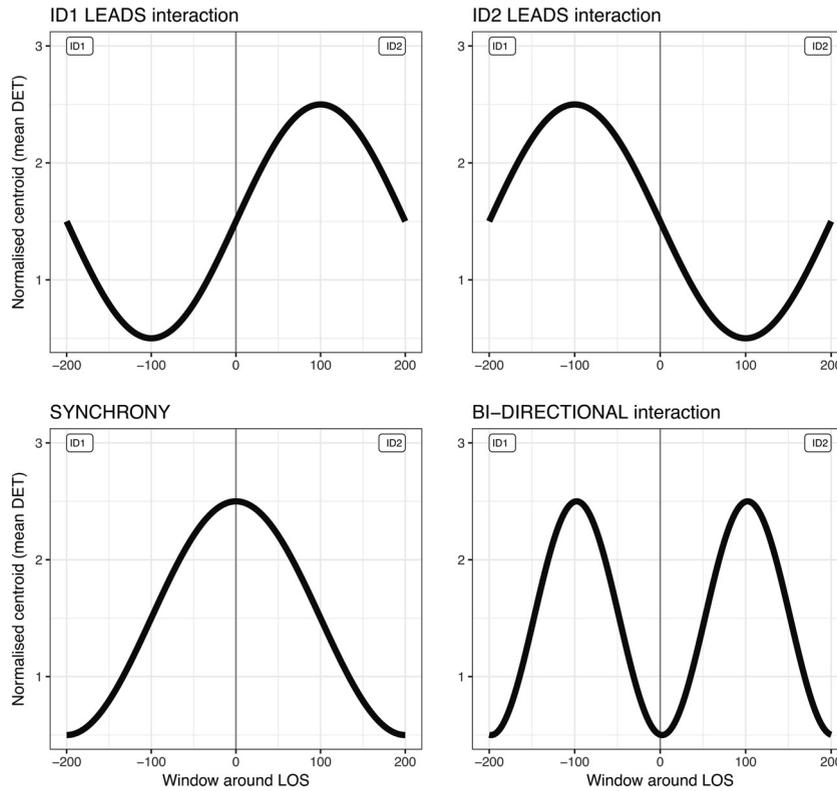
Fig. 2. Example diagonal-wise recurrence profiles showing possible leading-following patterns.

member did the same thing at about the same time and there was no clear leader or follower. A peak on both sides indicated bi-directionality or turn taking in the interaction: sometimes the better performing dyad member lead and sometimes the worse performing dyad member lead.

The DRPs of individual dyads were grouped based on their cooperative task performance; those that scored low (0%–25% percentile), average (25%–75% percentile), and high (75%–100% percentile); within these percentile groups the DRPs were aggregated for Regular and Special education groups separately. The low-scoring dyads finished 3–6 puzzles, the average group finished 7–10 puzzles, and the high-scoring group finished 11–15 puzzles. Note that for the children attending special-primary education, only five dyads finished 11–15 puzzles.

The aggregated DRPs shown in Fig. 3 are *centroids* obtained with the shape extraction algorithm in R package *dtwclust* (R Core Team, 2017; Sarda-Espinosa, 2017). This algorithm uses a shape-based distance metric on coefficient-normalized cross-correlation functions to generate the mean shape or centroid profile (cf. Paparrizos & Gravano, 2015). The thick lines in Fig. 3 are smoothed lines (loess, span = .2) with a 95% confidence interval of a lighter color. The spiky lines are the actual mean profiles. The bottom two rows represent the mean score + 95% bootstrapped CI. We chose to look at DET (z score, represented on the Y-axis) as it reflects the long-range recurrent trajectories in an interaction and not only occasional steady point similarities.

3. Results

3.1. Descriptive statistics

Dyads from regular primary education (*Mean* correct = 9.2, *SD* = 2.6, *n* = 183) performed better than dyads from special primary education (*Mean* correct = 6.8, *SD* = 1.8, *n* = 106). There were no mean group differences in popularity or likeability as these scores were standardized within classrooms.

3.2. Leader-follower analyses

We used the individual measure of popularity to distinguish between the individuals making up a dyad. We put the more popular dyad member on the left side of the graph and the less popular dyad member on the right side. This makes the results easier to interpret, as it made dyads comparable. It also made it possible to identify whether the more or less popular dyad member was in the lead. Fig. 3 shows the leader-follower results of the three performance groups (low, average, high), distinguishing between children without developmental disabilities in regular education (the lighter line) and children with developmental disabilities in special
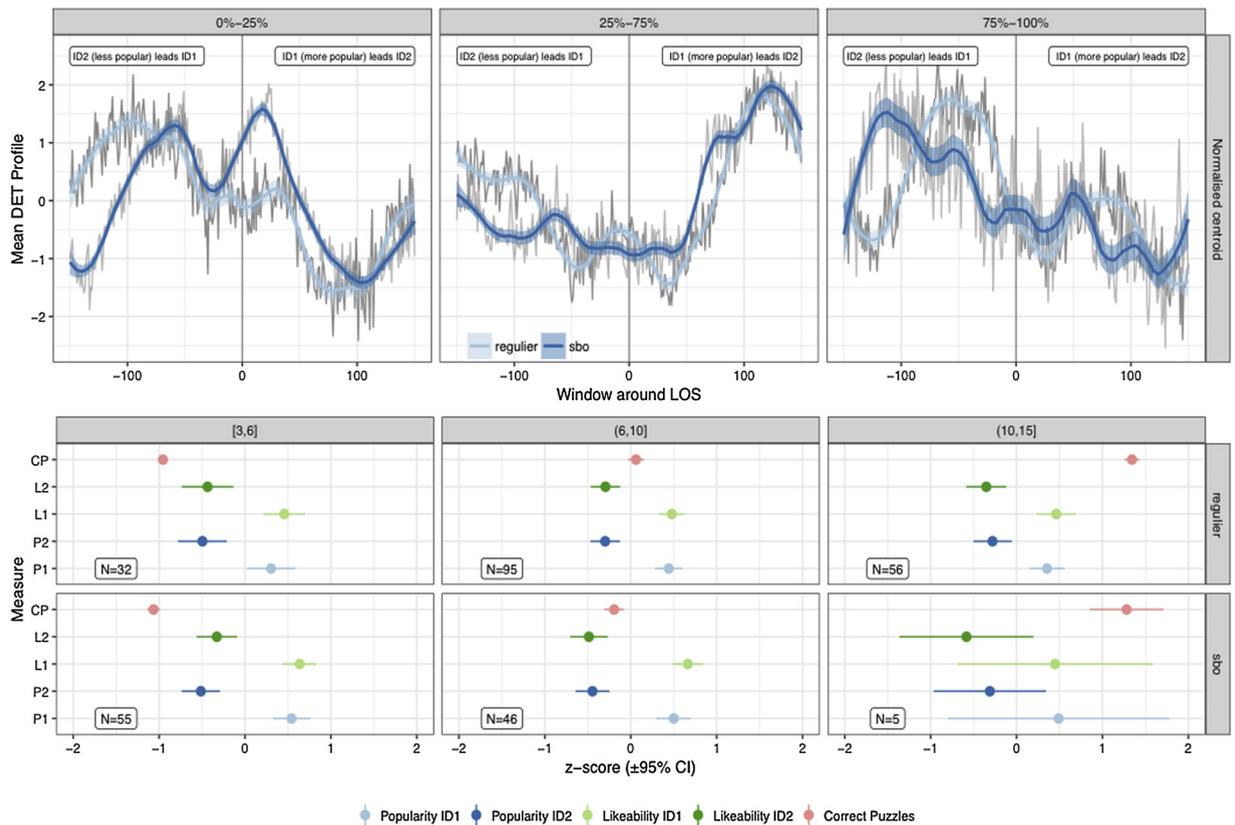
Fig. 3. Leading-following profiles for children in regular and special primary education. Dyads are grouped based on their cooperative task performance score. The figure distinguishes between the 25% lowest-scoring dyads (left side of the figure), the average 50% (middle of the figure), and the highest 25% (right side of the figure). The more popular dyad member is presented on the left side of each of the graphs, the less popular member on the right side. The dots below show the z scores for puzzles correct as a dyad and the individual popularity of participant 1 (ID1) and participant 2 (ID2).

education (the darker line). Below each graph, the z-scores for the number of puzzles correct and the popularity of each dyad member are plotted.

On the left side of Fig. 3, the results of low-scoring dyads are presented. We see different patterns for the two groups. For children in regular education, the less popular dyad member was in the lead. For children in special primary education, there was a bidirectional alignment; sometimes the popular dyad member lead (peak on the right side of the graph) and sometimes the less popular dyad member lead (peak on the left side of the graph). There was no clear leader or follower in this group.

In the middle of Fig. 3, the results for average-scoring dyads are presented. Here, results were similar for both groups. For both groups, the peak was clearly on the right side of the graph, indicating that the more popular dyad member was in the lead, while the less popular dyad member followed.

The results for high-scoring dyads are presented on the right side of Fig. 3. The pattern for both groups was similar, but opposite to that of average scoring dyads. Here, the less popular dyad member was in the lead, while the more popular dyad member followed. The peak of the regular education group was closer to zero than the peak of the special education group, indicating a smaller lag. This means that following was slower in special education dyads than in regular education dyads.

Thus, Fig. 3 shows who leads and who follows based on the level of popularity of the dyad members. However, it does not tell us which dyad member is 'smarter,' that is, had the highest pretest score. To address whether the pretest score was related to popularity (i.e., if it was a smart popular or unpopular child), we performed an additional analysis. Fig. 4 presents the result. It shows the performance of individual children on the pretest, what the scores were for the less and more popular dyad member, and how this differed between groups based on their cooperation score.

Fig. 3 showed that in the lowest 25% the less popular child in regular education was in the lead. Fig. 4 adds that the highest pretest score in this group was obtained by the more popular child in these dyads. In the average 50% group, the more popular child was in the lead while the less popular child had the highest pretest score. In the highest 25%, the less popular child was in the lead, but there was no difference between the children in how well they performed on the pretest; their scores were similar. Table 1 gives an overview of these results.

Fig. 3 showed that the lowest 25% of special education children had no clear leader; sometimes the more popular child was in the lead and sometimes the less popular child. Fig. 4 adds that these dyads also did not differ on their pretest score. In the average 50%,
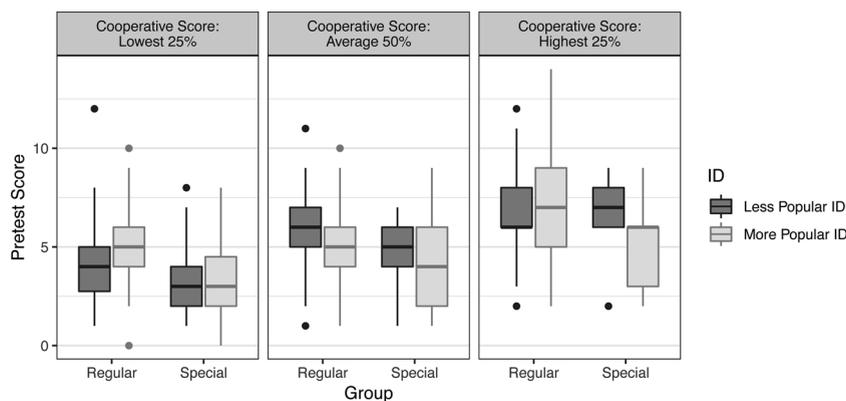
Fig. 4. Boxplots showing performance on the pretest of individuals within dyads, distinguishing the more and less popular child across the different groups (i.e., lowest 25% cooperative scores, average 50% cooperative scores, highest 25% cooperative scores). On the Y-axis is the individual pretest score; the X-axis shows which group the boxplots relate to; the dark grey box is the individual pretest score of the less popular dyad member; the light grey box is the individual pretest score of the more popular dyad member.

Table 1
Leadership Behaviour related to Popularity, Cooperative Task Performance, and Pretest Score.

Cooperative score	Lowest 25%	Average 50%	Highest 25%
Regular education			
Leader	less popular	more popular	less popular
Highest pretest score	more popular	less popular	equal
Special education			
Leader	equal	more popular	less popular
Highest pretest score	equal	less popular[1]	less popular[2]

Note. 1 = small difference, 2 = large difference.

the more popular child was in the lead and there was a small difference in the pretest scores of the dyad members, such that the less popular child had a slightly higher pretest score. In the highest 25%, the less popular child was in the lead and the difference in pretest scores ws even larger, again in favor of the less popular child. Thus, there was a shift across the three groups, in which the difference in pretest score became larger as the dyad performed better, and the less popular child obtained the highest pretest scores. Table 1 gives an overview of these results.

4. Discussion

The goal of this study was to examine the role of social status in dyadic interactions while performing a cooperative learning task. We examined how popularity was related to leading and following during cooperation and whether performance during the pretest was related. Furthermore, we compared dyads from regular and special primary education.

4.1. Regular primary education

The best performing dyads had a less popular leader and there was no difference in how 'smart' the dyad members were. That is, their pretest scores were similar. Thus, who leads and who follows in these dyads is determined by their social status (i.e., their popularity). In other words, these dyads had a follower that was a smart popular member. These smart popular children are both socially skilled and they get good grades (Senior & Anderson, 1993). And since these children are often more modest about their academic achievement (i.e., they do not brag about it), their performance is more acceptable to their peers (Rentzsch, Schütz, & Schröder-Abé, 2011). Potentially, these smart popular children are better able to follow the lead of a less popular child.

In average-performing dyads, the observed pattern was opposite to that of high-performing dyads. Here, the more popular dyad member took the lead. This was expected based on previous research that has shown that popular youths have leadership qualities and are often seen as leaders by their peers (Lease et al., 2002; Puckett et al., 2008). This appears to also affect performance in a dyadic cooperative game. Individual performance was not related to who leads and follows, since the best performance in these groups was obtained by the less popular dyad member. Thus, in average dyads, role division seemed to be influenced by the social dynamics of the peer group at large.

The most surprising results were found for the lowest-performing dyads: The pattern was similar to that of high performing dyads (i.e., the less popular dyad member was in the lead). This cannot be explained by their cognitive abilities, since they were the lowest performers. However, it may be possible that in the low-performing dyads the level of likeability influenced who led and who

followed, instead of popularity, as was the case in the best-performing dyads. This idea is supported by research that has shown an association between being disliked and low academic achievement (Wentzel & Caldwell, 1997).

In the present study, the least popular dyad members were also the least liked (see confidence intervals in Fig. 3 for L1 and L2), suggesting that in these dyads leaders may have been rejected children. Indeed, previous research has indicated that rejected children are disliked by many and liked by few (Coie et al., 1982), which was also the case for the leaders in the low-performing dyads (see confidence intervals in Fig. 3). It is possible that these rejected children took on the role of leader in an attempt to be accepted, trying to have the other dyad member cooperate with them. However, correlational studies have also shown a link between being rejected and less prosocial behavior (Asher & Coie, 1990; Wentzel & McNamara, 1999). Thus, it may also be that because they showed less prosocial behavior, these dyads were characterized by (at least) one dyad member who was unwilling to cooperate (i.e., the rejected child). A final possible explanation is that due to the rejected status of one of the dyad members, the other dyad member was unwilling to cooperate with this child, resulting in only the rejected child performing the task. Further research should investigate the mechanisms at play in these interactions and examine these possibilities.

4.2. Special primary education

In the group of children attending special education, high-performing dyads had a leader who was the lesser popular child. In addition, the less popular child in these dyads was also the 'smarter' one, performing better on the pretest. Thus, in these dyads performance may be determined more by cognitive abilities than by individual popularity, since the less popular children were the smarter ones (Senior & Anderson, 1993). These children often put a lot of effort in achievement (Rentzsch, Schütz, & Schröder-Abé, 2011), which in this case may have been visible in better performance on the tangram task. Although these children are smart, they may lack social skills. Perhaps, the high-performing but less popular dyad member may have been doing all the work, while the more popular dyad member got a "free ride". The socially more apt member of a dyad who cooperates with a high performing member may thus rely on the smarter individual's capabilities. Although the present study encouraged cooperation, it was not demanded, because it lacked individual accountability, that is, one member could do the task by herself (see Johnson & Johnson, 1996). Therefore, the best performing dyads (from special education) may not have been the dyads that perform best because of cooperation, but one (very) smart member was doing all the work.

In average-performing dyads, the results were similar to those of the average-performing dyads from regular education. That is, the more popular dyad member took the lead while the less popular member performed best on the pretest. Thus, as for the average dyads from regular education, role division seemed to be primarily influenced by the social dynamics of the peer group at large and less by how smart the dyad members were.

Finally, for children with developmental disorder, the lowest-performing dyads had no clear leader or follower. This absence of clear leader-follower roles may explain their low performance. Researchers have postulated that especially children with a developmental disorder need clear leader-follower roles (e.g., Gernsbacher, 2006; Trevarthen & Daniel, 2005; Vink et al., 2018). More specifically, they showed that when the less capable dyad member was in the lead, these dyads performed best. The findings of this study support their finding, since the lowest performance in this group was accompanied by a pattern without a clear leader and follower. That is, these dyads may be too similar to distinguish these roles, since there was no difference in how popular or smart the members were.

4.3. Summary and future research

When we compare the results of the children attending regular primary education and those attending special primary education, overall we see a lot of similarities. In both groups, the best performing dyads have a leader that is the lesser popular of the two, while in de average performing dyads the leader is the more popular dyad member. However, in the lowest-performing dyads we did find a difference between the two groups. That is, in de lowest-performing dyads attending regular primary education the less popular member is in the lead, but in the lowest-performing dyads attending special primary education there is no clear leader.

Why there is this difference between the children attending regular and special education remains the question. Note that this study is the first to examine leader-follower behaviour in relation to popularity, and thus we will refrain from suggesting implications for educational practice. More research is needed before we are able to do so. First, follow-up studies will have to show whether or not the observed findings of the present study hold across different studies. In addition, future studies could examine whether similar results are observed in inclusive education, and whether these results resemble those of the regular primary education group in the present study, or whether it is more like the special primary education group. Only when these questions have been answered, then we are able to start thinking about how these findings can be translated to practical implications for the classroom.

5. Conclusion

This study was a first step in creating a picture of how leading and following during a cooperative task is determined by popularity and academic achievement. The present results corroborate, but also partially contradict, previous findings. An important addition is that for children with developmental disorders it appears important that there are clear leader-follower roles (Gernsbacher, 2006; Trevarthen & Daniel, 2005; Vink et al. (2018)). However, note that Vink et al. (2018) showed that in the best-performing dyads, the more competent member (i.e., with the highest pretest score) was in the lead. We showed that it is not (always) just about who is more competent, but that social factors, such as popularity, also affect who leads and who follows. Thus, care should be taken when

generalizing these findings to, for example, the classroom.

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