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Behaviour 153 (2016) 1075–1102

Behaviour
brill.com/beh

Play, aggressive conflict and reconciliation in pre-school children: what matters?

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Accepted 17 August 2016; published online 27 August 2016

Abstract
Play provides children with the opportunity to train in fundamental social skills, including conflict management. Here, we evaluate the management of play, aggressive conflict and reconciliation in 3- to 5-year-old preschool children. 3-year-old children show the highest levels of aggressive conflicts in free play, and do not reconcile their aggressive conflicts in the first months of the preschool year because they still lack social capacities to successfully manage interactions with peers. We found no gender bias in being aggressors or victims, but gender-typed traits were reflected in the expression of aggressiveness in same-sex peers for boys, who rely more on physical contacts than girls. Gender segregation in play is seen only in boys, regardless of age. Our results emphasize the importance of considering play, aggressive conflicts, and reconciliation as a whole, in order to obtain a comprehensive overview of the development of pre- and post-conflict dynamics in humans.

Keywords
gender-segregation, *Homo sapiens*, peaceful dynamics, social play, social competence development, physical aggressive contacts.

1. Introduction

The acquisition of appropriate interpersonal skills, or 'social competence', is fundamental for building successful and long-lasting relationships (Rose-Krasnor, 1997). In socially complex mammalian species, the acquisition of social competence requires a long period of time, with great apes and humans showing a developmental phase of many years in order to achieve

DOI 10.1163/1568539X-00003397

adequate social knowledge (Shantz & Hartup, 1992; Laursen et al., 1996). Life in complex social systems is cognitively so demanding that some scholars have suggested that sociality has been the main drive for the enlargement of brain size, particularly of the neocortex which is involved in higher functions (Dunbar & Shultz, 2007).

In children, one important context for the development of social competence is the preschool classroom where they are required to regularly interact with their peers (Green & Rechis, 2006). The preschool classroom represents a totally new social context for most children, as it has been reported that the management of relations among peers profoundly differs from that observed in the family milieu (Green & Cillessen, 2008). This difference inheres in the intrinsic nature of the relationship dynamics which show a vertical organization within the family, whereas they can be described as horizontal within peer groups (Shantz & Hobart, 1989). Early peer interactions provide the child with the opportunity to learn about and practise fundamental social skills, such as resource sharing, cooperation, emotional regulation and conflict management (Rubin et al., 1998; Green & Rechis, 2006).

An important context in which preschoolers can develop such abilities is free play. Free play is a versatile and plastic behaviour (Fagen, 1993; Špinka et al., 2001; Burghardt, 2005) which provides a training ground for the development and establishment of social skills (Power, 2000; Palagi et al., 2016). Play can foster friendship but, if not well managed, it can lead to overt hostility (Pellis & Pellis, 1998; Pellis et al., 2010; Palagi & Cordoni, 2012), two factors that constitute the core of social life.

During free play children, as well as animals, follow rules that are not formalized or pre-defined (Pellegrini, 2009; Palagi et al., 2016). Each new play session is a new item on the agenda during which the 'rules' are continually being redefined. Partners, age, context, physical and emotional states are continuously shifting. Thus, the formulation and application of such *hic et nunc* codes depend on vast arrays of variables that can change continuously (Palagi et al., 2016). Finally, unlike structured games and guided activities where the rules may be enforced by a third party (e.g., umpire, teacher), during free play not only are the rules negotiated by the playmates, but so is the enforcement of the agreed-upon rules. Therefore, managing new playful interactions requires sophisticated communicative, emotional and social skills.

1.1. Prediction 1: aggressive conflicts and context differences

Three different types of aggression have been described in children, who can engage in physical (more typical of males in all human cultures), direct verbal and indirect aggression (Osterman et al., 1998; Butovskaya & Kozitnsev, 1999a, b; Sutton & Smith, 1999; Butovskaya, 2001). Indirect aggression is defined as 'harming others through covert behaviours' (gossiping or spreading rumours) (Bjorkqvist et al., 1992). This behaviour, very difficult to observe, can be collected only by interviews and questionnaires (Butovskaya et al., 2010).

Here, we aimed to investigate aggressive conflicts (defined as any action in which a child bites, kicks, hits, or otherwise physically hurts another child, Verbeek & de Waal, 2001) and reconciliation, within the context of play in preschool children ranging from 3 to 5 years of age. Since guided activity provides more external structure and third-party enforcement than free play, we expected to find higher levels of aggressive conflicts during free play than during guided activities (e.g., games).

1.2. Prediction 2: aggressive conflicts and age differences

Since younger children still need to acquire the social competence necessary to fully develop the ability to cooperate in play, we expected to find higher level of aggressive conflicts during free play in 3-compared to 4/5-year old children. One of the limitations of this last issue is that it conflates children's age with prior experience in preschool and the longevity of peer relationships, even though these two factors are impossible to be disentangled. Obviously, this represents a limit to make inferences about age-related effects (e.g., developing social skills) because findings might also be explained by differences in experience and peer relationship history.

1.3. Prediction 3: aggressive conflicts and temporal differences

One of the first lessons that must be learned in new social situation is that concerning the balance between egoistic and altruistic drives, in a developmental trajectory gradually moving from a self-centred to a self-and-other-centred world, as empathic and cognitive capacities expand (Svetlova et al., 2010). This transition is evident when considering the strategy adopted by children competing for the control over a monopolisable and desirable resource. Developmental psychologists found that young children can solve

the resource control task through either a coercive (e.g., imposition, aggression) or a prosocial technique (e.g., persuasion, cooperation) (Charlesworth, 1996; Green & Cillessen, 2008; Svetlova et al., 2010). For younger children, flight or coercion are the most recurrent tactics, as social competence skills still need to be developed. Coercive resource control is also the preferred strategy when children enter a new social group because this tactic is used to establish dyadic and group level dominance relationships, which serve to minimize group-level aggression. Roseth and colleagues (2011) found that coercive resource control was highest at the start of the school year, then decreased thereafter, thanks to the arrangement of the social dominance structure within the group. Interestingly, these authors also found that the change trajectory for coercive resource control was nonlinear, as its rates increased again after spring vacation. Thus, it appears that a relatively brief separation from peers is sufficient to disrupt dominance relationships, and consequently, to increase the frequency of coercive resource control when the vacation is over (Roseth et al., 2011). Such findings suggest that coercive tactics help organize and stabilize the early peer group (Strayer & Noel, 1986). As children gradually develop social skills and establish hierarchical relationships with peers, however, they become able to adopt prosocial strategies by asserting their own needs while maintaining positive social relationships with others. Socially competent children frequently adopt prosocial strategies, are friendly and cooperative and are perceived by peers as more altruistic, and for these reasons they also score higher in the hierarchical structure of the group (Hawley, 2002, 2007; Bukowski, 2003; Roseth et al., 2007). Studies on children clearly demonstrate, on the one hand, that social dominance and competence are tightly linked and seem to constitute a positive feedback loop, in which one underpins and reinforces the other. On the other hand, deficiency in interpersonal skills leads to social rejection and isolation because socially incompetent children persist in adopting only overtly aggressive strategies because they are not able to self-regulate their emotions, to negotiate with peers and to manage conflicts (Vaughn & Waters, 1981; Hartup, 1983; Howes, 1987, 1988).

Since we had the possibility to follow pre-school children during four consecutive months (November–February) interrupted by Christmas holidays, and in accordance with results by Roseth and colleagues (2011), we expected an increase in the level of aggressive conflicts in January, when

children met again after vacation, and recreated their dominance relationships. We also predicted that this increase would be particularly evident in younger children who are less socially competent and, therefore, unable to adopt prosocial strategies to gain the control of a resource.

1.4. Prediction 4: gender segregation in free play

Several studies reported a sex-bias in resource control, with boys being more successful in obtaining access to limited resources (Green & Rechis, 2006; Green & Cillessen, 2008). This seems to be linked to early sex segregation and to the differences in play behaviour and aggressive conflict management in girls and boys. Girls tend to play in smaller groups than boys, engage in more intimate social interactions largely based on cooperation, and avoid physical aggression, preferring social isolation as punishment (Butovskaya et al., 2007, 2010). Conversely, boys play in bigger groups than girls, and attach much importance to dominance hierarchies by challenging others in an overt manner (Benenson et al., 2002; Roy & Benenson, 2002; Green & Rechis, 2006). Since early gender segregation in preschoolers seems to be a cross-culturally universal phenomenon already evident by the age of three (Sheldon, 1990; Rose & Rudolph, 2006), we expected to find differences in play distribution according to gender.

1.5. Prediction 5: gender differences in aggressive conflict dynamics

On the whole, studies show that interactions among boys are more competitive and flow into physical aggressive conflicts more frequently, whereas interactions among girls rely more on cooperation and aggression avoidance (Pellegrini, 1995; Smith, 1997; Kyratzis, 2000; Green & Cillessen, 2008). Accordingly, we also expected boys to rely more on overt aggressive conflicts than girls in our study.

1.6. Prediction 6: reconciliation and temporal/age differences

Conflict management is considered the outcome of a successful socialization process (Weinstein, 1969) which includes a myriad of strategies and behaviours aimed at (1) maintaining social harmony by conflict avoidance (i.e., peacekeeping) and (2) repairing the relationship damage caused by conflict (i.e., peacemaking). A peacemaking mechanism is post-conflict reconciliation, operationally defined as a selective increase, compared to baseline

levels, of affiliative contacts between former opponents soon after a conflict (Cords, 1993; Aureli et al., 2002). Reconciliation has a strong biological basis, as it has been found in several non-human animals, with most of the evidence coming from primates (Aureli & de Waal, 2000). Reconciliation in animals has been studied by applying the Post-Conflict/Matched-Control method (PC/MC, de Waal & Yoshihara, 1983) and the same methodology has been applied to studies of children (see Methods for details).

The PC/MC method has revealed that reconciliation is present in children with frequencies depending on age- and cultural-related factors (Butovskaya & Kozintsev, 1999; Ljungberg et al., 1999; Butovskaya et al., 2000; Butovskaya, 2001; Verbeek & de Waal, 2001; Fujisawa et al., 2005, 2006; Roseth et al., 2011). The ability to negotiate compromise during conflicts over limited resources would seem to be an important attribute for children to acquire during the early preschool years. Thus, socially competent children begin to recognize the need to use a range of strategies (e.g., prosocial and coercive) to meet their needs, whereas less competent children continue to use only overtly aggressive strategies (Green & Rechis, 2006). As reconciliation relies on social competence and experience (Aureli & de Waal, 2000; Aureli et al., 2002), we expected older children to engage in conciliatory contacts from the start of the pre-school year, while we expected younger children to begin to engage in reconciliation once the phase of familiarization/socialization has occurred.

1.7. Prediction 7: reconciliation and gender differences

Another critical factor influencing the probability of reconciliation is the social value of the partner (de Waal, 1989; Kappeler & van Schaik, 1992). In this regard, preschoolers may perceive intra-sex relationships as more valuable, and therefore reconciliation should be more frequent in same-sex dyads. So far, there is contrasting evidence about this issue, with some scholars reporting that gender segregation is associated with reconciliatory behaviour (Verbeek & de Waal, 2001), while others did not find such an effect (Killen & Naigles, 1995; Butovskaya & Kozintsev, 1999). Assuming gender segregation plays a role in shaping the occurrence of conciliatory contacts, we expected that same-sex dyads would be more likely to reconcile their aggressive conflicts.

2. Methods

2.1. The study group

The study was conducted at the Florinda public kindergarten, located in Tuscany (Italy), on 129 children belonging to 5 age-restricted classrooms: Fish (mean age ± SE in months: 38.75 ± 0.73; 14 boys and 11 girls), Chicks (38.67 ± 0.80; 13 boys and 6 girls), Rabbits (52.71 ± 0.51; 12 boys and 17 girls), Bears (63.07 ± 0.72; 21 boys and 7 girls) and Monkeys (52.25 ± 1.11; 4–5 years old; 13 boys and 15 girls). The majority of the children were from middle-income homes and about 96% of them were Italian (only 4% of children belonged to other ethnic groups, but all of them spoke the Italian language).

During our study period, 3-year-old children met each other for the first time within the classroom while, by contrast, 4- and 5-year-old children had known each other for at least one year. For this reason, we used this criterion to categorize them into two clusters: younger children ($N = 44$, Fish + Chicks) who were new to pre-school vs. older children ($N = 85$, Rabbits + Monkeys + Bears) who were previously enrolled.

Children stayed in classrooms of about 85 m^2 each, and they sometimes used two common open spaces of about 90 and 85 m^2, respectively, for physical activity and group activities. Each classroom was furnished with child-sized tables and chairs, dolls, carriages, dressing-up clothes, trains and tracks, hot wheels, toy dinosaurs, board and drawing games, building blocks, etc.

2.2. Data collection and procedures

We used the PC–MC method that was developed to study reconciliation in nonhuman primates (de Waal & Yoshihara, 1983) to study peer aggressive conflict and its sequelae in 129 Italian preschool children. Before commencing the study, we obtained informed consent both from the school board and parents (100%) for all children to be videotaped. We collected data by making continuous video recordings of the children, and then analysing the videos by identifying and describing all aggressive events and making post-conflict and matched-control observations (see below for the definition). During the video recording the observer maintained a broad camera angle in order to have a total view of the classroom and to monitor the activities of all children. Since any kind of interaction was filmed, we were able to analyse all the aggressive conflicts which occurred concurrently.

The observations took place daily over a 6-h period that spanned morning and early afternoon (including lunch time), in indoor class rooms, outdoor garden and dining hall, from November 2012 until February 2013 (a total of 69 days of observation). Observations were video-recorded with a tripod mounted camera (Samsung Camcorder HMX-F80BP). Prior to systematic data collection we time-tabled observations for each class across each day of the school-week (from Monday to Friday). When observations were carried out inside, the observer (E.C.) stayed out of the classroom with his camera, in front of a big glass wall, thus having a good overall view of the children without interfering with their ordinary activities. A pre-school induction period, lasting from September to the beginning of November, was provided for younger children to facilitate their integration. For this reason, in order to explore the possible influence of the different phases of children's socialization on post-conflict behaviour, we examined data according to two distinct periods: Period 1 (before Christmas holidays), November–December 2012; and Period 2 (after Christmas holidays), January–February 2013.

We collected the agonistic interactions (i.e., overt aggressive conflicts) occurring during the video-recordings via the all-occurrence sampling method (Fish + Chicks = 54.5 h; Rabbits + Monkeys + Bears = 119 h). This method can be applied when (i) observational conditions are excellent, (ii) the behavior is sufficiently 'attention-attracting' so that all cases will be observed, and (iii) the behavioral events never occur too frequently to record (Altmann, 1974).

By scan sampling (1-min interval; 60 h of total observation; mean number of scans of each child = 460) we estimated the amount of time children engaged in free play and guided activity. Since the number of scans was different for each child (e.g., absence from school, out of sight), we normalized the rates of interactions recorded for a particular subject using the number of his/her hours of observation.

After a training period performed by the first author (G.C.), during which inter-rater reliability was established for child identity (name, sex, role in the aggressive conflict as victim or aggressor), behavioural patterns performed (aggressive, affiliative and playful patterns) and aggressive conflict codes (context, type — decided/undecided and intensity of aggressive conflict, presence of supporters — see below for definitions of each parameter), the third author (E.C.) analyzed the videos. The first author (G.C.) assessed the reliability for the video analysis twice. Cohen's kappa never below 0.82.

2.3. Operational definitions and statistics

2.3.1. Aggressive conflicts

For each aggressive conflict we recorded: (1) the opponents' identities, (2) context (circumstance in which the act of aggressive conflict took place), (3) type of aggressive conflict (decided or undecided), (4) aggressive behavioural patterns (see Table 1) and (5) possible supporters of victim or aggressor. We recorded overt physical aggressive conflicts, rather than verbal ones to permit direct comparisons with non-human primate species.

We distinguished two main aggressive conflict contexts: free play, and structured games guided by the teacher. We considered as decided aggressive conflicts those interactions in which aggressors and victims were clearly identifiable. A child was labelled as the victim when he/she ran away from the aggressor, in some cases crying and screaming. In order to be conservative, we discarded from the analyses all the undecided agonistic encounters during which it was not possible to clearly distinguish victim and aggressor.

Table 1.
List of behavioural patterns recorded under aggressive contexts.

	Children aggressive patterns
Bite	A child aggressively bites any part of a fellow child's body
Pull	A child aggressively pulls a fellow child or pulls a fellow child's hair
Shelter	A child shelters him/herself from the attack of a fellow child during a conflict
Hold back	A child aggressively stops or holds a fellow child back
Object hit	A child uses an object to aggressively hit a fellow child
Pinch	A child aggressively pinches any part of a fellow child's body
Pull object	A child aggressively throws an object against a fellow child
Push	A child aggressively pushes a fellow child
Punch	A child aggressively punches a fellow child
Slap	A child aggressively slaps a fellow child
Shake	A child aggressively shakes a fellow child's body
Object competition	A child aggressively competes with a fellow child for obtaining an object by pulling it towards him/herself
Kick	A child aggressively kicks a fellow child
Avoid	A child avoids any kind of interaction with a particular fellow child
Chase	A child aggressively chases a fellow child
Cry	A child (usually the victim) cries during or just after a conflict
Flee	A child flees while aggressively chasing by a fellow child
Scream	A child (usually the victim) screams during or just after a conflict

Aggressive conflicts were distinguished according to two levels of intensity: low intensity — aggressive conflicts without any kind of physical contact (e.g., threats and chase-fleeing) and high intensity — aggressive conflicts with physical contact (e.g., biting, slapping, pushing, pulling).

For each aggressive conflict, all instances of agonistic support — defined as a third party joining a dyadic aggressive conflict and attacking one of the opponents, thus providing support to the other opponent — were recorded along with the identities of the supporters and recipients of the support. Aggressive conflict frequency was calculated as the number of agonistic events divided by the total hours of observation.

2.3.2. Post-conflict behaviour

After the last aggressive element of any agonistic event, we conducted 5-min focal sampling (Post-Conflict observation, PC) on the victim and/or the aggressor. Each PC was matched with a 5-min Matched-Control focal sample (MC), which was conducted on the next possible day at the same time as the original PC, on the same focal individual, in the same context, in the absence of any agonistic interaction during the 30-min preceding the start of the MC and when the opponents had the opportunity to interact (de Waal & Yoshihara, 1983). This procedure ensured that the data collection (PC/MC) was independent of the context of the aggressive conflict and, therefore, of the rates of aggressive conflict performed during a particular activity (e.g., free play). This PC/MC method was used to control for the potential bias linked to the context of aggression.

2.3.3. Affiliation

Both for PCs and MCs we recorded: (1) starting time (min), (2) type of first affiliative interaction (physical contact, touching, embracing, kissing, object offering, playing), (3) exact min of the first affiliative interaction and (4) initiator of the affiliation.

For each focal individual (the victim and/or the aggressor) we determined the number of attracted, dispersed and neutral pairs overall PC–MC pairs by considering all affiliative contacts between the victim and the aggressor occurring both in PCs and MCs. In attracted pairs, such contacts occurred earlier in the PC than in the MC (or not occur at all in the MC). In dispersed pairs the contacts occurred earlier in the MC than in the PC (or not occur at all in the PC). In neutral pairs, affiliative contacts occurred during the same minute in the PC and the MC, or no contact occurred in either the PC or the

MC. As a measure of victim-aggressor post-conflict affiliation, we employed the Corrected Conciliatory Tendency (CCT), which is equal to the numbers of attracted pairs minus the numbers of dispersed pairs divided by the total number of PC–MC pairs.

We examined which factors predicted the presence of post-conflict affiliative contacts between victim and aggressor via a Generalized Linear Mixed Model analysis (GLMM). The presence/absence of reconciliation was the binomial dependent variable (Table 2). The fixed factors considered were: individual characteristics (age of the victim, age of the aggressor, victim-aggressor sex combination), aggressive conflict characteristics (decided/undecided, high/low intensity) and the period (Period 1, before Christmas holidays; Period 2, after Christmas holidays) (Table 2). Victim and aggressor were entered as random factors (nominal variables; Table 2). The dependent variable was distributed according to a binomial function. We tested models for each combination involving the variables of interest (Table 2), spanning from a single-variable model to a model including all the fixed factors (full model). To select the best model, we used the Akaike's Corrected Information Criterion (AICc), a measure for comparing mixed

Table 2.
Description of the variables used in GLMM analyses on the occurrence of reconciliation.

Name	Type
Dependent variable	
Occurrence of reconciliation	Binomial (0 = no; 1 = yes)
Fixed explanatory variables	
Individual characteristics	
Sex combination	Ordinal (1 = male–male; 2 = male–female; 3 = female–female; 4 = female–male)
Aggressor age in months	Scale
Victim age in months	Scale
Conflict characteristics	
Decided–Undecided conflict	Nominal (1 = decided; 2 = undecided)
Intensity of conflict	Nominal (1 = high intensity; 2 = low intensity)
Period of observation	Nominal (1 = Period 1, before Christmas holidays; 2 = Period 2, after Christmas holidays)
Random variables	
Aggressor identity	
Victim identity	

models based on the −2 (Restricted) log likelihood. The AICc corrects the Akaike's Information Criterion (AIC) for small sample sizes. As the sample size increases, the AICc converges to AIC. The model with a lower value of AICc was considered to be the best model. In order to measure the extent of improvement of the best model compared to the next best models, we calculated the difference (Δ_i or ΔAIC_{Ci}) between the AIC_C value of the best model and the AIC_C value for each of the other models. As suggested by Symonds & Moussalli (2011, p. 17) "...as a coarse guide, models with Δ_i values less than 2 are considered to be essentially as good as the best model, and models with Δ_i up to 6 should probably not be discounted. Above this, model rejection might be considered, and certainly models with Δ_i values greater than 10 are sufficiently poorer than the best AIC model as to be considered implausible". In order to assess the relative strength of each candidate model, we employed Δ_i to calculate the Akaike weight (w_i). The w_i (ranging from 0 to 1) is the weight of evidence or probability that a given model is the best model, taking into account the data and set of candidate models (Symonds & Moussalli, 2011).

For analyses of variables with normal distribution, we applied parametric statistics. In case of non normality of data, non parametric tests were used. Statistical analyses were performed with SPSS 20.0 (SPSS Inc., Chicago, IL, USA). The level of significance was set at 5% for all the analyses.

3. Results

3.1. Preliminary analysis

We recorded a total of 55 aggressive conflicts in Chicks (44 involving males and 11 involving females as victims), 84 in Fish (50 involving males and 34 involving females as victims), 43 in Rabbits (21 involving males and 22 involving females as victims), 35 in Bears (33 involving males and 2 involving females as victims) and 37 in Monkeys (19 involving males and 18 involving females as victims).

Since our sample was composed by two classes of younger children (Fish and Chicks) and three classes of older children (Rabbits, Monkeys and Bears), before combining the data we checked for possible differences in aggressive conflict and free play levels between the same-age classes. We found no difference between Fish and Chicks in the levels of aggressive conflicts occurring both during guided activity (Mann–Whitney $U = 226$, $N_{Fish} = 25$,

$N_{\text{Chicks}} = 19$, $p = 0.726$) and free play (Mann–Whitney $U = 219$, $N_{\text{Fish}} = 25$, $N_{\text{Chicks}} = 19$, $p = 0.660$). We obtained the same results also for the comparison between classes of older children (Kruskal–Wallis guided activity: $\chi^2 = 0.182$, df $= 2$, $N_{\text{Rabbits}} = 29$, $N_{\text{Monkeys}} = 28$, $N_{\text{Bears}} = 28$, $p = 0.913$; free play: $\chi^2 = 1.432$, df $= 2$, $N_{\text{Rabbits}} = 29$, $N_{\text{Monkeys}} = 28$, $N_{\text{Bears}} = 28$, $p = 0.489$). With regard to free play levels, we found no statistical difference between Fish and Chicks (Mann–Whitney $U = 188.5$, $N_{\text{Fish}} = 25$, $N_{\text{Chicks}} = 19$, $p = 0.245$) or between Rabbits, Monkeys and Bears (One-Way ANOVA $F = 1.681$, df $= 2$, $N_{\text{Rabbits}} = 29$, $N_{\text{Monkeys}} = 28$, $N_{\text{Bears}} = 28$, $p = 0.193$).

3.2. Prediction 1: aggressive conflicts and context differences

The children belonging to the two age-classes (younger children 3 yrs old; older children 4–5 yrs old) engaged in significantly higher levels of aggressive conflicts during free play than during guided activity (younger children: Wilcoxon test $T = 16.00$, ties $= 15$, $N = 44$, $p = 0.0001$; $\text{Mean}_{\text{freeplay}} = 0.1523 \pm 0.025$, $\text{Mean}_{\text{guidedactivity}} = 0.0286 \pm 0.0068$. Older children: Paired sample t-test $t = 5.017$, df $= 84$, $p = 0.0001$; $\text{Mean}_{\text{freeplay}} = 0.0506 \pm 0.0069$, $\text{Mean}_{\text{guidedactivity}} = 0.0142 \pm 0.00313$).

3.3. Prediction 2: aggressive conflicts and age differences

Comparing the aggressive conflict frequencies across the two different age-classes, we found no difference for aggressive events during the guided activity (Mann–Whitney $U = 1616.0$, $N_{\text{younger children}} = 44$, $N_{\text{older children}} = 85$, $p = 0.111$). By contrast, during free play, younger children showed a higher frequency of aggressive conflicts compared to older ones (Mann–Whitney $U = 1235.0$, $N_{\text{younger children}} = 44$, $N_{\text{older children}} = 85$, $p = 0.001$; Figure 1).

3.4. Prediction 3: aggressive conflicts and temporal differences

Focussing on aggressive conflicts during free play, we found a significant difference in aggressive conflict frequencies across the four months of observations (from November to February) for both younger (Friedman test $\text{MeanRank}_{\text{November}} = 1.58$, $\text{MR}_{\text{December}} = 3.33$, $\text{MR}_{\text{January}} = 3.53$, $\text{MR}_{\text{February}} = 1.56$, $\chi^2 = 37.827$, df $= 3$, $N = 18$, $p = 0.0001$; Mean Aggression Frequency $\pm$ SD: $\text{MAF}_{\text{November}} = 0.31 \pm 0.52$; $\text{MAF}_{\text{December}} = 3.45 \pm 1.05$; $\text{MAF}_{\text{January}} = 4.82 \pm 2.84$; $\text{MAF}_{\text{February}} = 0.49 \pm 0.52$; Figure 2a) and older children (Friedman test $\text{MeanRank}_{\text{November}} = 3.06$, $\text{MR}_{\text{December}} =$

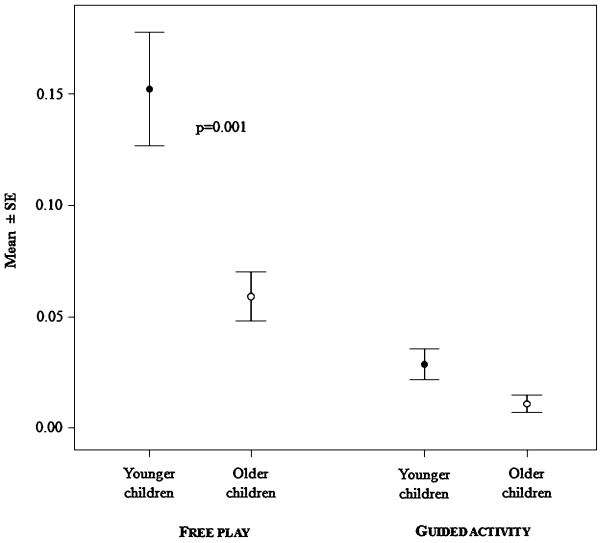

Figure 1. Comparison of aggressive conflict hourly frequencies across the two age-classes considered (younger and older children) both during free play and guided activity.

2.71, $MR_{January} = 1.88$, $MR_{February} = 2.35$, $\chi^2 = 8.111$, df $= 3$, $N = 17$, $p = 0.044$; Mean Aggression Frequency $\pm$ SD: $MAF_{November} = 0.26 \pm 0.21$; $MAF_{December} = 0.20 \pm 0.14$; $MAF_{January} = 0.19 \pm 0.45$; $MAF_{February} = 0.16 \pm 0.21$; Figure 2b). We used the Dunnett post-hoc test for pairwise comparisons between the different months. For younger children we obtained the following significant difference: $q_{Nov < Dec} = 7.43$, $p < 0.01$; $q_{Nov < Jan} = 5.85$, $p < 0.01$; $q_{Feb < Dec} = 5.31$, $p < 0.01$; $q_{Feb < Jan} = 4.58$, $p < 0.01$. By contrast, for older children we found the following statistical significance: $q_{Nov > Jan} = 2.66$, $p < 0.05$; $q_{Dec > Jan} = 2.42$, $p < 0.05$.

3.5. Prediction 4: gender segregation in free play

With regard to gender segregation in children's play, our results confirmed its overall presence, but also highlighted an age-related difference in its trajectory. Both younger (Wilcoxon test $T = 72.00$, ties $= 0$, $N = 23$, $p = 0.045$; $Mean_{MMplay} = 0.149 \pm 0.056$, $Mean_{MFplay} = 0.099 \pm 0.039$) and older boys preferred playing with males (Wilcoxon test $T = 133.00$, ties $= 0$, $N = 42$, $p = 0.0001$; $Mean_{MMplay} = 0.210 \pm 0.042$, $Mean_{MFplay} = 0.041 \pm 0.008$). On the other hand, girls' preference for playing with same-sex peers started at the age of four/five (Wilcoxon test $T = 154.00$, ties $= 0$, $N = 35$, $p = 0.007$; $Mean_{FFplay} = 0.093 \pm 0.022$, $Mean_{FMplay} = 0.044 \pm$

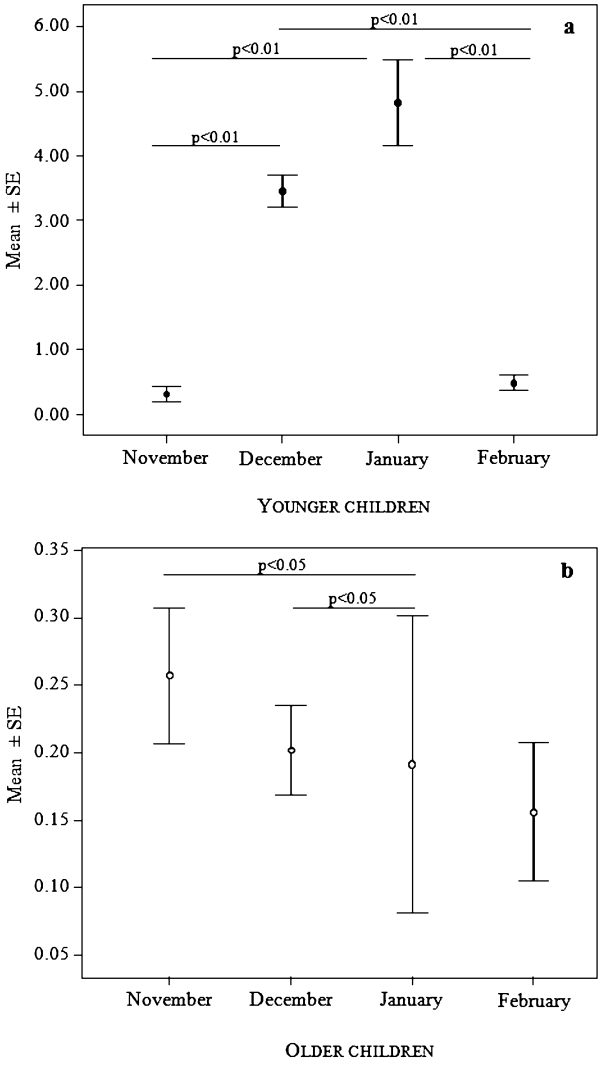

Figure 2. Hourly frequencies of aggressive conflicts across the four months of observation in younger (a) and older (b) children.

0.012), indeed, 3-years old girls showed no sex preference regarding playmates (Wilcoxon test $T = 33.00$, ties $= 0$, $N = 15$, $p = 0.135$; $\text{Mean}_{\text{FFplay}} = 0.123 \pm 0.045$, $\text{Mean}_{\text{FMplay}} = 0.056 \pm 0.021$) (Figure 3a). (The analyses of play distribution according to sex were performed only on those subjects showing at least one playful session.)

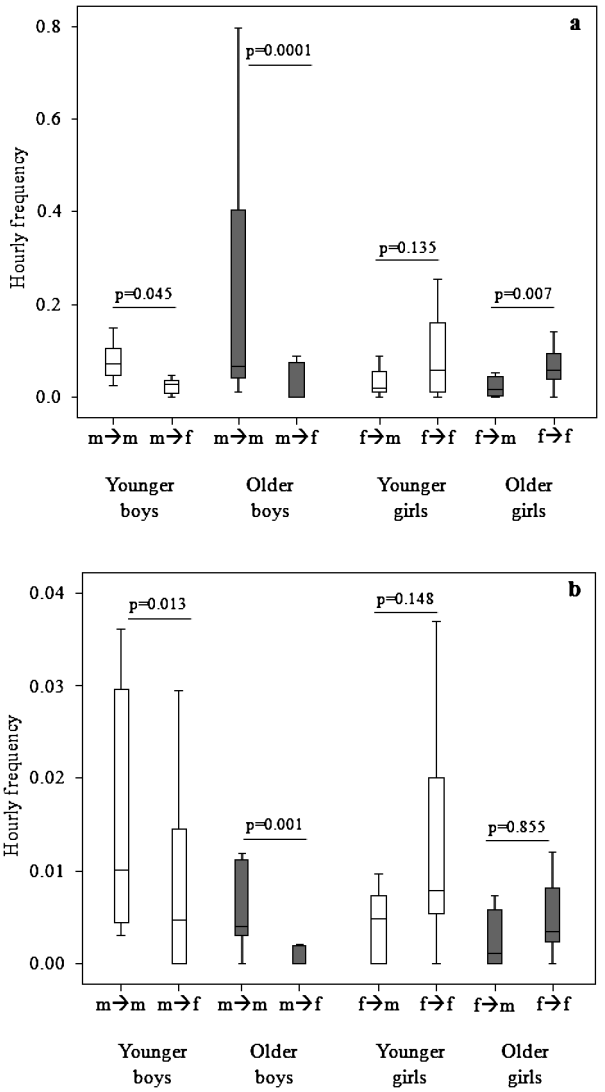

Figure 3. Hourly frequency of play (a) and aggressive conflicts (b) distribution according to the gender of the subjects involved in both younger and older children (m = male; f = female).

3.6. Prediction 5: gender differences in aggressive conflicts dynamics

We found that both boys and girls initiated aggressive encounters with comparable frequencies both in younger (Mann–Whitney exact test $U = 180.0$,

$N_{\text{females}} = 17$, $N_{\text{males}} = 27$, $p = 0.216$) and older children (Independent sample t-test $t = -1.058$, df $= 83$, $N_{\text{females}} = 39$, $N_{\text{males}} = 46$, $p = 0.293$). Considering boys and girls as victims, we similarly obtained no significant difference either for younger (Mann–Whitney $U = 219.00$, $N_{\text{females}} = 17$, $N_{\text{males}} = 27$, $p = 0.797$) or older children (Independent sample t-test $t = 1.350$, $N_{\text{females}} = 39$, $N_{\text{males}} = 46$, $p = 0.181$). However, the distribution of intra- and inter-sex aggressive conflicts differed. Specifically, both younger and older boys directed agonistic attacks more frequently towards other boys (younger boys, Wilcoxon test $T = 25.00$, ties $= 0$, $N = 17$, $p = 0.013$; older boys; Wilcoxon test $T = 66.00$, ties $= 0$, $N = 28$, $p = 0.001$) (Figure 3b). Neither younger (Wilcoxon test $T = 7.00$, ties $= 0$, $N = 8$, $p = 0.148$) nor older girls (Wilcoxon test $T = 49.00$, ties $= 0$, $N = 14$, $p = 0.855$) showed any difference according to the sex of the target (Figure 3b) (the analyses of aggressive conflict distribution according to sex were performed only on those subjects showing at least one aggressive event).

3.7. Prediction 6: reconciliation and temporal/age differences

To be conservative, we explored post-aggressive conflict dynamics only in those individuals with at least 3 PC–MC pairs.

In Period 1 (November–December, before Christmas holidays), we did not find any evidence of reconciliation in younger children (attracted-dispersed pairs; Wilcoxon exact test $T_{1\text{min}} = 6.0$, ties $= 11$, $N = 17$, $p = 0.317$; $T_{2\text{min}} = 6.0$, ties $= 12$, $N = 17$, $p = 0.655$; $T_{3\text{min}} = 0.00$, ties $= 15$, $N = 17$, $p = 0.157$; $T_{4\text{min}} = 0.00$, ties $= 16$, $N = 17$, $p = 0.317$; $T_{5\text{min}} = 0.00$, ties $= 16$, $N = 17$, $p = 0.317$). Conversely, in Period 2 (January–February, after Christmas holidays), affiliative contacts were significantly more frequent in PCs compared to MCs, but only in the first min after the aggressive conflict (Wilcoxon exact test $T_{1\text{min}} = 15$, ties $= 8$, $N = 20$, $p = 0.048$, CCT (mean $\pm$ SE) $= 14.04 \pm 8.06\%$; $T_{2\text{min}} = 7.50$, ties $= 16$, $N = 20$, $p = 0.317$; $T_{3\text{min}} = 1.50$, ties $= 18$, $N = 20$, $p = 1.00$; $T_{4\text{min}} = 2.0$, ties $= 17$, $N = 20$, $p = 0.564$; $T_{5\text{min}} = 0.00$, ties $= 19$, $N = 20$, $p = 0.317$). With regard to older children, the frequencies of affiliative contacts were significantly higher in PCs compared to MCs only in the first post-conflict minute in both periods (Period 1: Wilcoxon exact test $T_{1\text{min}} = 10$, ties $= 11$, $N = 21$, $p = 0.050$, CCT $= 14.30 \pm 7.12\%$; $T_{2\text{min}} = 2.50$, ties $= 17$, $N = 21$, $p = 0.317$; $T_{3\text{min}} = 2.00$, ties $= 18$, $N = 21$, $p = 0.56$; $T_{4\text{min}} = 0.0$, ties $= 21$, $N = 21$, $p = 1.00$; $T_{5\text{min}} = 0.00$, ties $= 21$, $N = 21$, $p = 1.00$; Period 2: Wilcoxon

exact test $T_{1\text{min}} = 0.0$, ties $= 10$, $N = 16$, $p = 0.031$; CCT $= 16.67 \pm 8.19\%$; $T_{2\text{min}} = 0.0$, ties $= 14$, $N = 16$, $p = 0.500$; $T_{3\text{min}} = 1.50$, ties $= 14$, $N = 16$, $p = 1.00$; $T_{4\text{min}} = 2.00$, ties $= 13$, $N = 16$, $p = 1.00$; $T_{5\text{min}} = 0.00$, ties $= 15$, $N = 16$, $p = 1.00$).

3.8. Prediction 7: reconciliation and gender differences

We found no evidence of the influence of gender on reconciliation levels for either younger (Mann–Whitney exact test $U = 70.00$, $N_{\text{female victims}} = 10$, $N_{\text{male victims}} = 19$, $p = 0.226$) or older children (Mann–Whitney exact test $U = 74.50$, $N_{\text{female victims}} = 10$, $N_{\text{male victims}} = 21$, $p = 0.174$).

Using GLMM, we established which variables explained the occurrence of reconciliation. We found that the best model included the intercept only (AICc $= 1099.339$) and had a w_i of 0.589, i.e., there is 58.9% probability that it is really the best model describing the occurrence of reconciliation. However, it should be noted that the nearest model to the best one included the period (AICc $= 1100.213$) and had a w_i of 0.380, i.e., there is 38.0% of probability that it concurred in describing the occurrence of reconciliation. Since the difference between the two AICc values < 1, these two models must be considered as equally valid. The full model was the worst one (AICc $=$ 1158.255).

4. Discussion

The management of interpersonal relations among children is strongly influenced by the social and environmental context in which they are embedded. Although teachers were asked not to intervene during aggressive encounters in both contexts (free play vs. guided activity) and to let children resolve them by themselves, the frequency of aggressive conflicts was much higher during free play sessions when compared to guided activities for both younger and older children (Prediction 1 supported). Several factors may explain this difference. Firstly, guided activities are built on *a priori* rules and children have to adhere to them to avoid being penalized or excluded from interacting with peers. Certainly, the close presence of the teacher, by acting as a mediator, helps adherence to rules. Therefore, during guided activities, children just need to know and abide by the rules, and do not really have to independently manage the session to make it successful, which is more complicated because it relies on the development of personal social

skills. Moreover, the teacher can implement anticipatory forms of appeasement (i.e., strategies that prevent potential aggression from arising; Keltner et al., 1997) which lower the probability of aggressive conflict and the degree of competition during the interaction. Our data are in line with the study by Ostrov & Keating (2004), who found that the levels of physical aggression was lower during structured activity than during free play in 4–6 year-old children.

In free play rules are established *hic et nunc* (i.e., here and now) and depend heavily on children's skills to correctly interact with peers. These unformalized rules are mediated by complex instinctive and neural mechanisms (Pellegrini, 2009) and, in children, they can also be shaped by educational and cultural factors. Therefore, during free play sessions children must rely on their social competence to prolong play and avoid escalation into aggressive conflict. In all probability, the low level of social competence in 3-year-old children explains the higher level of aggressive conflicts we observed during free play in younger than in older children (Prediction 2 supported). As children grow older, they develop more complex strategies of interacting with peers, and this is due to the development of empathic and cognitive abilities (intrinsic factors) but also to their social experience (extrinsic factors) (Green & Rechis, 2006; Svetlova et al., 2010). Aggressive conflicts in younger children commonly arise from their inability to reach a friendly compromise over the possession of a toy which translates into coercive strategies of resource control and, as a consequence, in overt aggressive conflict.

We then analysed how the frequency of aggressive conflicts varied along with the study period (from November to February) to evaluate if the two weeks of Christmas holidays were sufficient to destabilize children's hierarchical dynamics. Since established peer relationships also shape play and post-conflict dynamics, decreased rates of aggressive conflict are expected as children's relationships stabilize. Our results show that the frequency of aggressive conflicts significantly varied across the four months of observation; in fact, whereas older children began the school year with high rates of aggressive conflict that declined thereafter, the younger children's began the year with low rates of aggressive conflicts, increased aggressive conflicts through January, and then declined. These results suggest that the aggressive conflict variability is not attributable to the break of Christmas holidays (Prediction 3 not supported). In fact, in younger children the frequency of

aggressive conflicts was higher both before and after Christmas holidays (December and January) compared to November and February. After the initial period of pre-school induction (September/October), younger children could interact more freely due to the absence of their parents in the room. Therefore, November is the first month in which younger children start managing social relations with peers by themselves and the low level of aggressive conflicts occurring in this month might be explained by this factor. Once younger children have created a basic social network, aggressive conflicts begin to emerge to a greater extent to establish dominance relationships. The decrease in aggressive conflicts in February can be interpreted as the establishment of a dyadic and group hierarchy. In older children, who already knew each other at the start of the new pre-school year, aggressive conflicts appeared more randomly distributed, with November and December showing higher levels of aggressive conflicts compared to January, while in February aggressive conflict levels were intermediate. However, it is worth noting that hourly aggressive conflict frequency was extremely low (Figure 2b) which indicates a more stable social situation in older, compared to younger, children (Figure 2a). Accounts of group formation dynamics (Tuckman, 1965; Tuckman & Jensen, 1977) suggest that all groups develop in sequential-stages: in newly formed groups (like the 3-year-olds), conflict (storming) will rise after an initial period of determining group rules (forming) as individuals negotiate dominance relationships, and then will decrease as the group-level hierarchical structure stabilizes (norming). In addition, conflict should increase when group-level structure and norms de-stabilize — for example, when new members join a group or after prolonged separation (like summer or Christmas vacation) (Roseth et al., 2011). The present study, in line with Tuckman's account, supports and extends Roseth's two prior longitudinal studies (Roseth et al., 2007, 2011) by showing how time and extended breaks (the Christmas holiday) modify rates of aggressive conflicts depending on children's age, prior experience in preschool, and history of peer relationships. On the one hand, for younger children the lack of difference in aggressive conflict rates between December and January suggested the occurrence of an on-going negotiation for determining and stabilizing dominance relationships over the break. On the other hand, for older children our results suggested that the summer vacation disrupted the previously established group hierarchy and norms. The children began the negotiation of dominance relationships (storming) immediately, rather than starting with

a new formation period (i.e., low levels of initial aggressive conflicts). The Christmas break seems not to prolong this process of negotiation, because in January the level of aggressive conflicts decreased compared to November and December. Nevertheless, further studies are needed to confirm this evidence and to disentangle age from social-contextual factors.

Early gender segregation has been reported in several studies (Serbin et al., 1994; Moller & Serbin, 1996; Maccoby, 1998) and our data confirm its presence during free play (Prediction 4 supported) with some differences depending on age. Younger boys showed a statistically significant preference for boys, while girls of the same age did not show any same-sex bias in play. This result is in contrast with previous findings reporting that girls tend to show gender segregation earlier than boys (La Freniere et al., 1984). For both boys and girls, the preference for same-sex partners increases with age, becoming more marked at the age of four. Gender identity emerges at an early age (Martin et al., 2002) and is an important component of children's cognitive development. According to the Cognitive Consonance Hypothesis (Kohlberg, 1966), the emergence of gender identity is reflected in the preference for same-gender peers, resulting in gender-segregation and in the construction of gender-oriented characteristics, skills and roles. For this reason, once gender-segregation begins, it undergoes a self-reinforcement process, determining an increasingly marked same-gender affinity as children grow up. Moreover, the presence of gender-typed toys reinforces this process by creating two different play cultures that maintain and reinforce play segregation between boys and girls.

Several studies have reported that boys are more overtly aggressive than girls who, on the contrary, prefer to show social isolation as a form of punishment, what has been labelled as 'relational aggression' (Crick & Grotpeter, 1995). Our results showed no gender-related differences in the probability of being aggressors or victims, either in younger or older children, however, the frequency of aggressive conflicts was higher between same-sex compared to cross-sex peers in boys (Prediction 5 partially supported). This distribution was found for boys in all age groups, indicating that boys played more competitively and relied more on aggressive conflicts than girls and, as a result, play gender-segregation reflected aggressive conflict gender-segregation. A different pattern was found in younger girls, who did not show any same-sex preference either in play or in aggressive conflict. By contrast, aggressive conflicts among older girls did not differ from those between girls

and boys, although gender-segregation in play was markedly present in this age-class. Therefore, our results suggest that, in line with many previous studies (Pellegrini, 1995; Smith, 1997; Fujisawa et al., 2008), girls play more cooperatively, or avoid aggression, by relying more on relational than overt aggression.

Focussing on post-conflict mechanisms, we found that the occurrence of reconciliation depended on the period of the school year and on the age group considered. Younger children did not reconcile their aggressive encounters in the two months preceding Christmas holidays (Period 1) but this behaviour emerged in January and February (Period 2), with peak frequency in the first minute after the end of the aggressive conflict (Prediction 6 supported). In older children, reconciliation occurred in both periods, and affiliative contacts were also higher in the first minute after aggressive conflict (Prediction 6 supported). Reconciliation is a complex phenomenon which requires developed social skills. Its complexity emerges from the results of the GLMM analysis which did not show a significant influence of any of the variables considered (see Table 3). Younger children may not be able to reconcile their aggressive conflicts in the first months of the preschool year because they probably still lack the social competence which is necessary to enact conciliatory behaviours. Additionally, younger children need time to strengthen social bonds, which

Table 3.
Best GLMM explaining the occurrence of reconciliation (Intercept, AICc = 1099.339; Period, AICc = 1100.213).

	t	*Z*	*P*
Fixed factors (AICc = 1099.339)			
Intercept	4.431		0.0001
Random factors			
Aggressor		1.210	0.226
Victim		0.302	0.763
Fixed factors (AICc = 1100.213)			
Period ($F = 0.162$, df2 = 247)			0.688
Intercept	3.357		0.0001
Random factors			
Aggressor		1.236	0.216
Victim		0.343	0.732

are fundamental in determining the probability of reconciliation occurring. Older children, thanks to their greater social competence and previous experiences and social bonds, are capable of putting in place all those strategies aimed at repairing the relationship damage caused by overt aggressive conflicts in order to recreate harmonious relations among peers.

The absence of gender influence on reconciliation (also confirmed by the GLMM) supports the view that both boys and girls of any age understand the importance of reconciling to prevent the disruption of social relationships (Prediction 7 not supported). Reconciliation is widespread in group living and cognitively complex mammalian species (Aureli et al., 2002). It is important to note that the timing of reconciliation in children mirrors that of many other non-human mammals (Cordoni & Palagi, 2008; Verbeek, 2008; Leone & Palagi, 2010; Cordoni & Norscia, 2014), suggesting that the urgency to reconcile has a strong adaptive value and is rooted in the biology of social living.

It would be interesting to evaluate how friendship shapes the distribution of play, aggressive conflicts and conciliatory contacts (Verbeek et al., 2000; Verbeek & de Waal, 2001; Aureli et al., 2002); although categorizing children's dyadic relationships is a difficult matter given that they frequently shift across time.

In conclusion, the absence of social competence and experience in 3-year-old children predicts high levels of aggressive conflicts during free play, thus suggesting that children lack the ability to manage their playful sessions in a peaceful and cooperative way (pre-conflict strategy). These children, in the first period of interaction, also lack the capacity or necessity to engage in post-conflict affiliation with stranger peers. Over time, younger children not only acquire the skills needed to engage in both pre- and post-conflict behavioural strategies, but they also create a network of valid social relations that needs to be maintained. A developmental trajectory in gender segregation is also evident in play and aggressive conflicts, but not in reconciliation which goes beyond the mere choice for same-sex partners. Finally, in the study of conflict management in pre-school children, play, aggressive conflicts and reconciliation are intertwined behaviours that cannot be disentangled if we want to reach an exhaustive overview on the development of peaceful dynamics in humans.

Acknowledgements

We wish to thank all the participants to the workshop 'Obstacles and catalysts of peaceful behaviour' held at Lorentz Center (Leiden, The Netherlands) organized by Peter Verbeek and Douglas Fry. We are very grateful to parents and children who took part in the project and to the teachers of the preschool 'Florinda' (Istituto Comprensivo Centro Migliarina Motto, Tuscany, Italy) for giving us the opportunity to carry out the study. We wish to thank Masi Campofiorin for elucidating some shady concepts and helping us in the interpretation of data. Finally, we are in debt to Lynne Murray for her accurate critical and stylistic revision of the manuscript.

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