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Research Article

THE EFFECTS OF AGE-MIXING ON PEER COOPERATION AND COMPETITION

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ABSTRACT
This study may be the first to directly test the hypothesis that mixed-age interaction can increase cooperation and reduce competition among peers. Twenty pairs of preschoolers (ages 4-6) were observed twice in same-gender triads in a play situation involving a limited-resource: once in a same-age triad of preschoolers and once in a mixed-age triad that included a child approximately 5 years older. Children in mixed-age groups spent more time playing, were more equitable in sharing the resource, better organized and more cooperative, with smoother turn-taking and higher performance scores in the game. Children in same-age groups spent more time interfering with the game or disengaged. These findings demonstrate the potential benefits of mixed-age interaction in school settings.

Key words: *cooperation, competition, mixed-aged socialization, peer relations*

INTRODUCTION
Competition among peers is inevitable because individuals often seek to acquire the same resources at the same time. This is especially true for same-age peers who often need the same resources to develop successfully. With experience, greater self-control and cognitive advances, the egoism of early childhood gives way to greater cooperation as individuals learn strategies to maintain social bonds and avoid ostracism. This increased cooperation in older children sometimes reflects strategic thinking and planning as individuals become accustomed to compromises, "realizing that it is better to get a portion of the resource than none at all, or to get none of the resource rather than to risk alienating someone who will be helpful later on" (Charlesworth, 1988, p. 55). Based upon these developmental considerations one would expect children in mixed-age groups to be more cooperative because older and younger children have different resource needs, and less of an inclination to directly compete for resources. After reviewing the theoretical rationale for the value of mixed-aged socialization in the past, we outline the hypothesis that mixed-age interaction can reduce competition and increase cooperation among peers.

Throughout 99% of human evolution mixed-age socialization was the norm and still is in contemporary hunter-gatherer societies (Konner, 2010; Tronick, Morelli, & Winn, 1989). Observation of children in six hunter-gatherer cultures (Hadza, Efe, Aka, Ache, Agta, and !Kung) reveals that mixed-age interaction provides children with a great diversity of stimulation and is their principal means of education. This social structure places cultural demands on young children to develop cooperation and group identification in these remarkably egalitarian societies (Winn, Morelli, & Tronick, 1989).

Mixed-age socialization is also prominent in many traditional societies where 5- to 10-year-old children often entertain and play with infants and toddlers (Watson-Gegeo & Gegeo, 1989; Whiting & Edwards, 1988; Whiting & Whiting, 1975). For example, Gaskins (2000) observed children's daily activities in a traditional Mayan village in Mexico, noting that older children (aged 6 to 11) organized symbolic play and assigned specific roles to the younger children. The themes of these play sessions were usually taken directly from adult life, such as playing house, hunting, or going to the market to sell produce. According to Gaskins, these activities are driven by the important cultural principle of engagement—the primacy of adult work. Mayan economic production is still rooted in the family where adults devote most of their time to work and leave young children with their elder siblings and peers. As Gaskins described it, "there is a strong sense that adult work must get done and that the child should, at the least, not interrupt it and, moreover, should contribute to the household work as needed and able" (Gaskins, 2000, p. 379). As with hunter-gather societies, children are guided by their elder siblings to engage in activities that resemble adult work, thus preparing them for the future. Older children model more difficult skills and younger children aspire to master these skills. Older children thus provide an important framework for accomplishing these increasingly challenging tasks, while minimizing boredom at each particular task.

The age segregation of children typically found in modern societies requires much larger numbers of children together in a community than was possible in hunter-gatherer societies in order to ensure sufficient numbers of children of the same age (Konner, 1975). Although most schools are age-segregated for educational reasons, mixed-age settings may still provide unique educational value and psychological benefits, as has been argued extensively by Gray (2011, 2013). For example, studies on peer tutoring in schools reveal that when tutors are 1–3 years older than those being tutored, there was a greater increase in understanding of the subject matter for both the tutors and those being tutored, compared with same-age control groups. Moreover, tutors showed gains in prosocial attitudes, self-esteem, and empathy (Topping & Ehly 1998; Yogev & Ronen 1982). Children in mixed-age classes appeared to like school better and to be more advanced in interpersonal intelligence than their peers in age-segregated classes (for a comprehensive review, see Lloyd, 1999).

Such benefits can also be found in nonacademic situations where children meet spontaneously and serve as important facilitators for one another (Rogoff, 1990). Using naturalistic observational methods, Gray and Feldman (2004) documented 196 naturally occurring interaction sequences between adolescents and children who were at least four years apart in the Sudbury Valley School, an alternative educational setting that allows free age-mixing throughout the school day. They found that children and adolescents appeared to be drawn to each other by their complementary interests in nurturing and being nurtured, and their interactions were characterized by common enjoyment, laughter and high-spirited play. The authors suggest that mixed-age play is less competitive because children are less likely to be concerned about winning, engaging instead in reciprocal activities that benefit both parties. For younger children, mixed-age play fostered problem solving skills and systematic thinking ability under the help and guidance of older children. For older children, it provided an ideal situation for the development of creativity and a unique opportunity to practice their nurturance and leadership skills in relaxed, joyful activities with a more lighthearted mood than typically found in same-age peer competition (Gray & Feldman, 2004; Gray 2013).

Experimental studies by Graziano et al. (1976) used a tower-building task to investigate individual and group performance of first- and third-grade children in same-age versus mixed-age triads. Whereas no differences were found on group performance, mixed-age conditions did stimulate greater task activity on the level of individual performance among the third graders but not the first graders. The failure to find any significant difference on the level of group was probably due to the use of nonverbal tower-building task that diminished the occurrence of verbal behaviors that typically characterize children's daily interaction. Moreover, the authors coded behaviors that were directed at tower building instead of the other children in the group. Verbal behavior was coded in terms of the number of utterances, but not their content, thereby obscuring the social interaction of the children in the group. Finally, the task is cooperative as it requires coordinated efforts from group members for successful completion, but does not induce competition. Except for Graziano's study, very few studies have so far focused on mixed-age interactions among children. Gray (2011) recently scrutinized every issue of the journals Child Development and Developmental Psychology published from 2000 to 2010 and found only 4 articles that were related to the interactions among non-sibling children who were at least 24 months apart. Hence, any research on this topic is quite sparse.

This may be the first experimental study to explicitly examine the effects of age mixing on children's cooperation and competition using a limited resource paradigm. This methodology has been used extensively to observe how children deal with potential conflicts where both cooperation and competition often arise (Charlesworth & LaFreniere, 1983; French et al., 2011; LaFreniere & Charlesworth, 1987; LaFreniere, 1996). An important aspect of preschool peer competence is the ability to engage peers in sustained cooperative play without becoming a victim of their often egoistic orientation. Charlesworth & LaFreniere (1983) developed a standardized situation in which access to a desirable resource was limited and could only be achieved by cooperation. Preschoolers worked in four-child groups with a movie-viewer that required that one child crank the apparatus, and a second child hold down a light switch in order that a third child view the cartoon strip. Friends were able to generate more total viewing time for their group as a whole, and they were more harmonious, with more frequent turn-taking, than groups of familiar children who were not friends.

In subsequent experimental work we decided to specifically examine preschool boys' abilities to regulate disappointment, frustration and anger in order to achieve positively toned cooperation with a peer (LaFreniere, 1996). Prior naturalistic observations had revealed that the primary proximate cause of aggression in early childhood was the frustration of losing a competition over a desirable resource. Based on these observations, we decided to induce mild frustration in an experimental situation by controlling the outcome of a competition. Preschool aged boys were instructed that the first one who completed his jigsaw puzzle would be awarded a prize. The boys typically competed enthusiastically. Success in the competition was characterized by broad smiling and triumphant looks at the partner with occasional boasting, while losing the competition was followed by looking down or away, frowning, slumping posture, and occasional whining or complaining.

In the ensuing cooperative play situation that required sharing an attractive toy, typically some form of turn taking prevailed, with each child employing the toy for a brief period. However, great variation in the degree of cooperation, conflict and competition was observed. Boys who were previously assessed by their preschool teachers as socially competent were typically able to regulate the mild negative emotion produced by the unequal outcome to the competition and subsequently were able to engage enthusiastically in play with a peer, with more cooperation and less competition and conflict than children who were less competent. In contrast, preschoolers with a history of problem behavior showed considerably more tension and less emotion regulation in their interaction with each other and were unable to sustain cooperation. In all of these studies using the limited-resource paradigm, a great deal of individual variation in cooperation and competition was observed among children, making the general paradigm ideal for the purposes of the present study, where we hypothesize that the presence of an older child will significantly reduce the degree of competition and increase cooperation in the group.

To adapt the task and make it interesting for both younger and older children, a new interactive video game involving an innovative motion sensing input device developed by Microsoft—Kinect was used. Since the video game allowed only two children to play, we created a limited resource by placing three children in the situation. Kinect has a built-in camera and sensor that allow the users to interact naturally with computers by simply gesturing and speaking (Microsoft Corporation, 2013). The movements and postures from the users are captured and projected on the TV screen connected to the Kinect.

Two specific hypotheses were tested. First, children in mixed-age groups were predicted to utilize the resource more efficiently (i.e., longer time spent in playing and higher game scores) and more equitably (i.e., more similar playing time among group members). Second, children in mixed-age groups were predicted to be more cooperative (e.g., more sharing, helping, and compliance to peer directives) and less competitive (e.g., less displacing and interfering) than children in same-age groups.

Materials and Methods

Participants

Sixty preschool to kindergarten children (*M*= 5.7 years; range = 4.3– 6.9 years, 27 girls and 33 boys) and twenty third to six graders (*M*= 10.4 years; range = 8.0– 12.8 years; 9 girls and 11 boys) from three suburban schools and five urban schools in the Northeastern United States participated in this study. Signed parental permission was obtained for all participating children. The children were mostly European-American children from middle-class families. They were assigned to either a same-age triad (three younger children) or mixed-age triad (two younger children and one older child). Thus, twenty pairs of younger children were tested twice: once in a same-age triad and once in a mixed-age triad. All the groups were composed of same-gender children. Each child in a triad was drawn from a different school in order to equate unfamiliarity across experimental conditions. Also, a counterbalanced procedure was used to avoid carryover effects by testing 9 groups of children first in a same-aged triad and 11 groups of children first in a mixed-aged triad.[1]

Apparatus

The Xbox 360 is a video game console developed by and produced for Microsoft. The Kinect is an add-on sensor device of Xbox 360 that enables users to control and interact with the Xbox 360 by using gestures and spoken commands. The postures and movements of users are projected on a TV screen that is connected to the Xbox 360 and the Kinect. A video game River rush that is appropriate for children of preschool age and above was chosen. In this game, two players facing the Kinect sensor stayed in a designated area marked by a square of green tape. Their characters were represented on the screen, standing in a raft (see Figure 1 for a screenshot from the game). By jumping together, the players started their journey in the raft, rushing down a river. They can control the raft by moving their bodies. For example, to steer the raft the players need to lean their bodies from side to side or they can jump to leap the raft into the air. Players can also earn some points by catching the coins in the air or going between some particular markers. The goal for the players is to keep the raft in motion and earn as many points as possible. Each course of journey lasted about 3 or 4 minutes. In the end, a score would appear on the screen showing how many points each player had earned during the round.

Figure 1: A screenshot from River Rush

[1] The counterbalanced procedure was not enforced on one same-age group because one of the subjects in that group did not arrive at the appointed time.

Video Equipment

A Cannon videocamera was mounted on a toy rack about 3 feet away from the TV screen and 4 feet above the floor. This videocamera has a built-in microphone that can clearly capture the sound in the laboratory room and the voices from the children. The equipment was placed in an inconspicuous location so that it would not attract prolonged attention from the children.

Procedure

Three children were led by a research assistant to a laboratory room. First, a research assistant explained and demonstrated how to operate and play the game to all three children and then reminded them that only two people can play at one time, *so you must take turns, OK*? Then the research assistant left the room and the children were allowed to play the game for 20 minutes with no adults present. After 20 minutes, the research assistant re-entered the room to end the play session. The entire activity in the laboratory room was videotaped and also observed through a one-way mirror so that interventions could be provided if necessary.

Codes for individual behaviors

Individual behaviors were coded as actions and responses. Actions are the behaviors that initiate interaction, including displacing, commanding, asking or seeking permission, modeling, verbally instructing, physically helping, offering position, forming alliances, appealing to rules, seeking help, proposing, assigning tasks, summarizing, refocusing, reminding, selecting players, and soliciting opinions. Responses consisted of the behaviors that occurred in direct response to the actions within 5 seconds. Included in this category were resisting, obeying, ignoring, accepting, and giving help or permission (see Appendix A for the coding manual of individual behaviors). The analysis was conducted on the frequencies of these behaviors.

Codes for resource utilization

Resource utilization was defined by the number of seconds that each child spent in each of the following five positions:

1. Playing: the child was playing the game in the designated area or the child was selecting the options in the menu by putting his/her palm towards the TV screen;
2. Onlooking: the child was staying outside of the designated area and watching other children playing the game without actually engaging in it;
3. Interfering: the child was making some intended physical contacts such as squeezing and pushing, or the child was creating some difficulties for the children who were playing the game such as blocking the TV screen;
4. Unoccupied: The child was neither playing nor onlooking but was wandering around aimlessly or staring off into some places other than the TV screen.
5. Other: The child's behavior was not described by the categories listed above (e.g., the child was off camera or left the laboratory room).

A resource inequity score was derived from each group by dividing the sum of all pairwise differences of three children's playing time by their total playing time. A higher resource inequity score indicates a less equitable sharing of the game among the children. Research assistants recorded the score generated by the Xbox 360 after each course of the game. The score were the points that the players earned during the course and it reflected players' understanding and implementation of the instruction (e.g., go between the markers and catch the coins over the air). An average score was calculated from each group for further analysis.

Reliability

All sessions were videotaped and then coded by two trained research assistants who were blind to the ages of the children and the hypotheses of the study. Interrater agreement was obtained from the coding of 15% of the observations. Cohen's κ (.89) was calculated for the categories of individual behaviors and the omission (i.e., one observer coded the behavior but the other did not) was 19%. For the coding of resource utilization, the observers agreed on 78% of the circumstances where the coding on each position was less than 50 seconds difference. The different scores in resource utilization were averaged for subsequent analyses.

Results

Analyses were conducted on three levels. First, the actions and responses of each child were analyzed. Second, the time that each child spent in each of the five positions was compared for same-age groups vs. mixed-age groups. For the analyses on these two levels, independent sample t-tests and pair sample t-tests were used to assess individual differences of all participants and then the participants attending both same-age settings and mixed-age settings (hereafter repeated-measures dyads), respectively. Third, resource inequity and game performance were assessed to compare group functioning between the same-age condition and mixed-age condition.

Individual behaviors

Individual behaviors are composed of actions and responses from each child. Some of the actions and responses were combined to create more meaningful categories. Specifically, the actions of physically helping, modeling, verbally instructing and offering position were merged into one category called cooperation, whereas competition only consisted of displacing. Leadership was a combination of commanding, assigning tasks and selecting players. The actions of forming alliances, soliciting opinions, seeking help, appealing to rules and summarizing were excluded from analysis because of very low frequencies. In terms of responses, obeying, accepting and giving help or permission were classified into compliance while noncompliance included resisting and ignoring.

In Table 1, the actions of children in same-age groups and mixed-age groups are displayed. Overall, children in mixed-age groups were more cooperative than children in same-age groups, $t(62)=-3.54$, $p<.001$. Further analyses indicated that these cooperative behaviors were more frequently initiated by older children in mixed-age groups than their younger counterparts in same-age groups, $t(20)=-2.81$, $p<.01$. Also, older children more often reminded others of previously established rules than younger children, $t(26)=-2.14$, $p<.05$. Children in the same-age groups, on the other hand, were more likely to ask permissions from their group members, $t(78)=1.97$, $p<.05$. There were no differences between the two groups on competition and leadership, $t(100)=.12$, $t(100)=-1.03$, $p>.05$, respectively. Neither were there any significant differences in children's responses to actions.

Table 1
Between-subject comparison of children's behaviors in same-age groups and mixed-age groups

	Same-age group		Mixed-age group		
Category	M	SD	M	SD	t
Cooperation	0.47	1.72	3.04	4.89	-3.54***
Competition	0.27	1.02	0.25	0.56	0.12
Leadership	6.45	6.65	8.22	10.28	-1.03
Asking permission	0.33	0.68	0.12	0.38	1.97*
Proposing	0.31	0.84	0.25	0.98	0.33
Reminding of rules	0.67	0.95	0.59	1.19	0.37
Refocusing on the game	0.20	0.72	0.10	0.41	0.84

*$p < .05$. *** $p < .001$.

Sex differences were found for the frequencies of actions and responses as boys both initiated more actions and also more frequently responded to group members than girls, $t(57)=2.51$, $t(57)=2.50$, $p<.01$, respectively. When the differences on the frequencies of actions and responses were controlled by using a percentage score, further analyses revealed no differences on any of the actions and responses between boys and girls.

For repeated-measures dyads, paired sample t-tests were conducted to examine if children's behaviors varied as a function of context. As shown in Table 2, children in same-age settings had more actions of asking permission from other children, reminding others of previously established rules, and refocusing of group effort on the game, $t(36)=1.96$, $p<.05$, $t(36)=3.10$, $p=.002$, and $t(36)=1.78$, $p<.05$, respectively. The comparisons on the base rates of cooperation, competition and leadership showed no significant difference between the two settings. However, further analysis on the children in mixed-age settings did reveal greater conditional rates of cooperation in two different ways. When responding to cooperative behaviors, these children showed more compliance, $t(26)=-2.30$, $p<.05$, and when they responded to leadership, they showed fewer non-compliance responses $t(37)=1.73$, $p<.05$.

Table 2
Within-subject comparison of children's behaviors in same-age and mixed-age settings

	Same-age setting		Mixed-age setting		
Category	*M*	*SD*	*M*	*SD*	*t*
Actions					
Asking permission	0.35	0.63	0.14	0.42	1.96*
Reminding of rules	0.76	1.01	0.16	0.50	3.10**
Refocusing on the game	0.22	0.79	0.05	0.33	1.78*
Cooperation	2.05	3.37	1.27	1.91	1.33
Competition	0.27	0.61	0.22	0.53	0.50
Leadership	6.78	7.31	7.24	11.13	-0.26
Proposing	0.35	0.86	0.14	0.54	1.31
Responses					
Compliance to cooperation	1.59	1.80	2.96	2.79	-2.30*
Non-compliance to leadership	1.74	2.74	0.92	1.57	1.73*

*$p < .05$. **$p < .01$.

Time for different positions

Summing the time across all the participants on each of the five positions revealed significant differences in playing, interfering and being unoccupied. More specifically, children in mixed-age groups spent more time playing the game, $t(118)=-1.72$, $p<.05$, while children in same-age groups spent more time in the position of interfering and being unoccupied, $t(69)= 3.10$, $p=.001$, $t(90)=2.16$, $p=.017$, respectively (see Figure 2). These differences were confirmed by the shorter time spent on interfering and being unoccupied while slightly longer time for playing in the older children in mixed-age groups than their younger counterparts children in same-age groups, $t(19)=2.72$, $p=.007$, $t(22)=2.80$, $p=.005$, $t(38)=-1.34$, $p=.095$, respectively. Sex differences were not found for time spent in any of the positions.

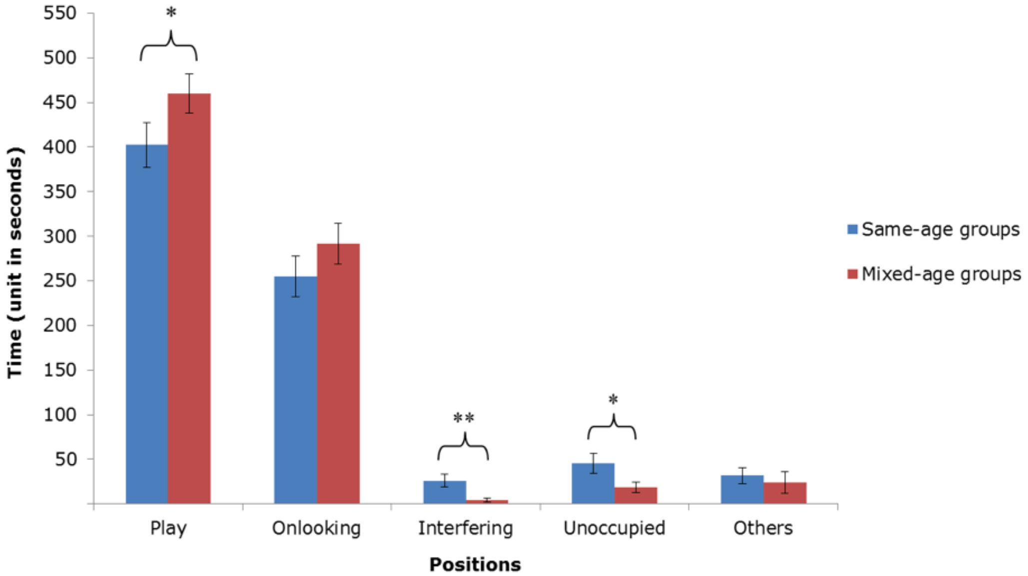

Figure 2: Time for different positions across all the participants between same-age groups and mixed-age groups. Error bars represent standard error of the mean (*p<.05 **p <.01).

Group functioning

Group functioning was assessed by resource inequity and game performance. Resource inequity was computed by the ratio of the sum of pairwise differences of playing time between every two children to the total playing time of the three children. Therefore, the higher this score, the less equitable time spent in sharing the game. As in Table 3, same-age groups were shown to have a higher score on resource inequity than mixed-age groups, $t(30) = 1.76$, $p<.05$. In terms of game performance, children in mixed-age groups earned significantly higher scores from the game than children in same-age groups, $t(37)=-3.27$, $p=.001$.

Table 3
Group functioning of children in same-age groups and mixed-age groups

	Same-age setting		Mixed-age setting		
Category	*M*	*SD*	*M*	*SD*	*t*
Resource inequity	0.63	0.43	0.43	0.25	1.76*
Game performance	32.85	11.93	43.81	8.81	–3.27**

*p < .05. **p < .01.

Discussion

In general, results indicated that children in mixed-age groups spent more time playing, were more cooperative and equitable in sharing the resource, and were better organized, with higher performance scores than children in same-age groups. This higher degree of cooperation, defined as physically helping, modeling, instructing and offering a turn to play the game, was mostly due to the behavior of the older children. This is consistent with past findings that prosocial and instructive behaviors are more likely to be directed from older to younger children rather than between same-age peers (Ludeke & Hartup, 1983). Younger children, in turn, often look to older children for help and instruction and are more likely to accept guidance from them than from same-age peers. Younger children may seek assistance from an older child because she is more competent rather than because she is older. The higher performance scores of preschoolers in mixed-age groups indicate that with the help of older children, younger children were able to understand the game better. Finally, unlike mixed-age groups where older children actively shared the resource with younger children, children in same-age groups needed to make more direct requests to play the game, often to no avail. In reviewing children's social interaction with same- and different-age mates, French (1987) found that symmetric interaction involving reciprocal behaviors (e.g., tit-for-tat aggression) are more likely to occur among individuals who are equal in status, whereas asymmetric interaction featuring complementary behaviors (e.g., instruction) commonly emerge between individuals who differ in status.

It should be pointed out that the situation in this study was not as competitive as the one created by Charlesworth & LaFreniere (1983), where four children were competing for one resource. Thus, the absence of the predicted difference in overt competitive behaviors between same- and mixed-age groups can be attributed to the very low frequency of these behaviors in all groups (less than 1 percent). Even though overt competition was mostly absent, nevertheless older children managed to play the game more than the younger children. Similarly, subtle competition was revealed in the form of the less equitable outcomes found in same-age groups compared with mixed-age groups. Because competition as a strategy to acquire or defend resources can take subtle forms, its presence or absence is ultimately determined by the distribution of resources. From this aspect, higher resource inequity reflects greater competition.

Taken together, the current results demonstrate the potential benefits of age mixing in children's socialization as advocated by scholars such as Peter Gray (2013). A practical question concerns the age gap that is optimal for mixed-aged interaction. One answer is to allow the children themselves to determine this, as is accomplished via free age-mixing in experimental schools, such as the Sudbury Valley School in Massachusetts. Another answer can be derived from developmental theories such as Piaget and Vygotsky. Vygotsky posited "zones of proximal development" that allow younger individuals to function at a higher level when in the presence of more accomplished peers. This view holds that there should be a certain distance in the actual developmental level between individuals for optimal learning to occur (Vygotsky, 1978). The age difference between younger and older children in this study generally reflects the distinction between preoperational and concrete operational period delineated in Piaget's stage theory. In the preoperational period (2 to 7), children are mostly egocentric and unable to take the perspective of others. This is shown by their tendency to focus on just one aspect of a situation in problem solving and neglect other viewpoints (i.e., centration). The decline of egocentrism is evident in children during the concrete operational period (7 to 11) when they learn to think from different perspectives. In experimental programs that allow for mixed-aged interaction as part of the more traditional curriculum, we recommend a similar age gap as that used in this study by combining children in the mid-preoperational stage with children who have attained mature concrete operations.

Moreover, unsupervised peer interaction provides children an opportunity to hone communication and emotion regulation skills, especially during emotionally arousing situations, as conflicts are sure to arise due to early childhood egocentrism. Programming out such conflicts by relentless adult supervision and interference in children's activities may actually be a disservice. This was one of Piaget's key insights. He advocated peer interaction, not parent or teacher tutoring, as the principal means by which young children shed their egocentrism and learn the importance of perspective-taking (Piaget, 1932).

With respect to peer tutoring, it should be acknowledged that the mean differences between same- and mixed-age groups that we have been discussing mask considerable individual variation within these groups. From the standpoint of educational policy this means that not all older children are necessarily well equipped to be tutors for their younger schoolmates. Programs involving peer tutors should then be somewhat selective. Despite this caveat we believe that mixed-aged interaction in the classroom (with teachers as monitors) or peer tutoring programs would be beneficial for both younger and older participants. Experimental programs would also likely benefit from detailed program evaluation.

Another caveat involves the limited generalizations possible due to the specific design features of this study. Within these constraints the study clearly demonstrates that the presence of one older child can significantly increase the cooperation and level of performance in a small group of younger children. Other research must be conducted to generalize to mixed-aged groups of different sizes that include multiple older children. It is possible that under such conditions groups of older children could form coalitions that exclude younger, less competent children. However, these consequences were not reported by Gray and Feldman (2004) in their naturalistic observation of free age mixing of children in different sized groups. In the end, the research strategy we recommend for future work in this area should employ different types of experimental designs, as well as naturalistic observation. Both types of studies would also benefit from highly trained observers whose inter-rater agreement is assured prior to the start of the study.

In conclusion, the mixed-age socialization that characterized children's activities in hunter-gatherer societies has largely been supplanted by modern age-segregated education. In addition, the age-mixed sibling interaction of a large family has also been greatly reduced in modern societies – Eastern and Western. And the mixed-aged interaction that formerly typified unsupervised play in our neighborhood parks has given way to adult-organized, age-segregated competitive team sports. Given the positive social and educational outcomes long attributed to unsupervised peer interaction and mixed aged interaction in particular, it may be time to begin reversing these trends. While education in traditional classrooms greatly enriches students' knowledge in the formal curriculum, public education should also serve equally important social goals. Mixed-age socialization, where children are less concerned with winning and more likely to learn about cooperation as a means to achieve joint goals, has long been advocated by evolutionary scholars (Gray, 2013) particularly in modern, individualistic societies The present study has implications for educational policy by demonstrating the potential value of mixed-age interaction as a supplementary approach for teaching and learning. For some topics that require a high degree of attention, involvement and interaction (e.g., cyber education), age mixing and peer tutoring might be particularly effective.

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