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AUTHOR Tudge, Jonathan
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ABSTRACT

A study was made to assess the extent to which social interaction is beneficial to cognitive development. A total of 154 boys and girls, 5 through 9 years of age, initially participated individually in a conservation-like pretest requiring prediction of the way a beam would tip when different numbers of weights were placed at differing distances from a fulcrum. Seven increasingly sophisticated rules for prediction have reliably been differentiated. On the basis of pretest results, children were assigned to (1) a control group in which children were again tested individually; (2) an "equal rule" group pairing same-age, same-sex, same-class children who had used the same prediction rule on the pretest; or (3) an "unequal rule" group pairing same-age, same-sex, same-class children who had used different prediction rules on the pretest. During treatment, disagreeing subjects resolved their disagreement in discussion. Subjects were individually post-tested twice and improvement in rule use was recorded. Findings indicated that interaction with a partner was not conducive to cognitive development. No significant improvement was found when equal rule and unequal rule groups were compared. Partners using a lower rule in the unequal rule group were the only children who improved; performance of higher partners worsened. Significant sex, age, and age by sex differences were found, with boys consistently benefitting more than did girls from the process of interaction. (RH)

Collaboration, conflict, and cognitive development: the efficacy of joint problem solving

Jon Tudge

Presented at EPA, New York City, 18 April, 1986

Piaget (1926, 1932) held that discussion among peers is a powerful force in cognitive developent, because it allows them to become aware of the different perspectives each brings to the matter being discussed. Over the last decade researchers in Europe (Doise and Mugny, 1979; Perret-Clermont, 1980) and this country (Murray, 1972, 1982), have begun to examine this contention. They have conducted research in order to explore the relationship between the social interaction of young children and their cognitive development in the context of problem solving tasks. Strong claims have been made for the efficacy of the "cognitive conflict" brought about by pairing children who have differing perspectives on the task (Mugny, Perret-Clermont, and Doise, 1981; Ames and Murray, 1982). These researchers have almost exclusively used conservation tasks - one or more conservers and a nonconserver are asked to consider some stimulus materials (quantity of liquid in different sized containers, for example), and reach a joint decision about them.

The results of this research, however, may not be generalizable to more common situations in which peers try to solve a problem together. The conserver always is correct in his/her judgment and is, in effect, an "expert", with the nonconserver tantamount to a "novice", who is always wrong.

The nature of this relationship, in which one partner has reached his/her developmental ceiling, may be qualitatively different from those in which development is possible even for the more advanced partner. If one wishes to argue that social interaction is beneficial for cognitive development in general, one must be able to show its potency in areas other than conservation.

Subjects

154 subjects, aged from 5-9, participated in the research. They were drawn from an open-enrollment public elementary school in downtown Ithaca, NY.

Breakdown of subjects, by age and gender

	male	female	mean age
kindergarten	25	26	66.6
1st-2nd grade	26	30	82.9
3rd-4th grade	20	29	111.7

Procedure

A balance beam, similar to that employed by Siegler (1976, 1981) was used. The task required that children predict which way a beam would tip when different numbers of weights were placed at differing distances from the fulcrum. Seven increasingly sophisticated rules for prediction can reliably be distinguished (Tudge, 1985). The methodology fitted the established form for this type of research - pretest, treatment, and two posttests - with improvement measured by the change from pretest score

(rule use). For the pretest and posttests the children were tested individually, to establish which rule was used. On the basis of pretest rule, children were assigned to one of three treatment conditions.

1. A control group, in which the children were again tested individually.

2. An "equal rule" group, in which each child was paired with another who used the same rule on the pretest.

3. An "unequal rule" group, in which the partners used different rules. The child who had used the lower rule was termed the "lower partner", the one who had used the higher rule being termed the "higher partner".

The children in each pair were of the same age, sex, and class in school. Disagreements in prediction were resolved by discussion. The first posttest took place approximately three days after the treatment (mean 3.89 days, SD 2.2), and the second posttest about a month later (mean 33.97 days, SD 4.14).

Results

If discussion between peers aids their cognitive development, pairs of children should have improved significantly more than individuals. As Table 1 shows, interaction with a partner was not conducive to cognitive development - children with partners were slightly more likely to improve than children with no partner, but this difference was not significant at the time of the treatment itself, nor at the time of the first or second posttest. Discussion, by itself, could therefore not be considered the key variable.

Children in the "unequal rule" treatment group necessarily brought different perspectives to bear on the problem (each child had used a different rule from that of his or her partner). "Cognitive conflict" was thus incorporated into this type of pairing; no such conflict was built into the "equal rule" pairing, as both partners had used the same rule at the time of the pretest. If cognitive conflict is an important mechanism for inducing cognitive development, one would expect that children in the "unequal rule" group would improve more than their peers in the "equal rule" group. As Table 2 and Figure 2 indicate, this did not prove to be the case. While the differences between the two groups of children were in the predicted direction and remained stable over time, the differences were not significant.

Turning from an analysis of pairs of children to analyses of individuals(1) allows an examination of the performances of the "lower partners" (those children who had used a lower rule at the time of the pretest than their partner) compared to the "higher partners" in the "unequal rule" group. As Table 3 show, lower partners improved far more than their higher partner counterparts. Moreover, as Figure 3 displays, the lower partners were the only children who improved; the higher partners, by contrast, fared worse than any other children. If "cognitive conflict" is the mechanism that brings about cognitive development, all children whose partner had used a different rule (whether higher or lower) should have improved. This clearly was not the case.

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(1) To ensure statistical independence of observations, one partner from each pair was excluded from these analyses, using a stratified random sampling procedure.

The situation is clearly more complex than researchers working in the Piagetian tradition have suggested. Furthermore, while they have found neither age nor gender effects, in the present research children of different ages and sex did not benefit equally from collaboration.

As Table 5 and Figure 5 show, boys and girls, across all conditions, performed quite differently. Boys tended to improve, whereas girls declined. Gender exerted, in fact, an appreciable influence, particularly at the time of the treatment. Its effect diminished somewhat over time, but still had a significant effect a month later. The condition by gender interaction was not significant, thereby indicating that girls did not perform differently from boys in some conditions but not in others.

Age also proved a significant factor - its effect, controlling for condition and gender, was significant at the time of the treatment, first posttest, and second posttest. As Table 5 and Figure 5 indicate, the kindergarteners and first-second graders tended to decline, whereas the third-fourth graders improved. They improved, in fact, significantly more than the younger children ($p < .006$ at the time of the treatment and first posttest, $p < .02$ at the time of the second posttest).

Neither the interaction of "age by condition" nor the three-way interaction of "age by sex by condition" proved significant. The "age by sex" interaction, however, was significant. As Figure 6 shows,(2) the effect was caused by the large sex differences shown by children from the first-second grade. Boys of this age group improved to a greater extent

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(2) For simplicity of presentation, information from the second posttest only is provided in this figure. The results from the treatment and first posttest were equally striking.

than any other group, while girls of this age declined more than any others. For the kindergartners and third-fourth graders, the gender differences were not statistically significant but, as Table 6 indicates, the differences were highly significant among first-second graders.

The gender differences, it should be noted, were still in evidence after "age" and the "age by sex" interaction were added to the model. In other words, boys consistently benefitted more from the process of interaction than did girls in each condition and at each age.

Implications and conclusions

The aim of this study was to keep the form of the research as similar as possible to that done earlier, while removing the content from the conservation paradigm. These results suggest that the findings earlier reported may be applicable not to peer collaboration in general, but primarily to a class of collaboration - between peer "experts" and "novices". In a situation in which development was possible even for the most advanced members of a pair (none of the subjects in this research used the highest rule), "conflict" between partners often resulted in the more advanced member declining. This was particularly true for younger children, and for girls in general.

The results reported by the Piagetian scholars who have examined the effects of peer interaction indicated that conservers do not regress when paired with nonconservers. It is likely that the reason why they do not regress is that they are more confident of their opinions than nonconservers. The conserver, after all, knows all that is to be known

about that particular domain of conservation, and will always provide a conservation response. One does not have to accept Piaget's view that a hallmark of conservers is that they understand the logical necessity for their views, but there is evidence that they are more confident of their opinions (Miller and Brownell, 1975; Miller, Brownell and Zukier, 1977). They are unlikely, therefore, to be swayed by the arguments of their nonconserving partners.

The age differences were expected; at present, one can only speculate about those of gender. It is possible that different socialization patterns play a role. First, boys are encouraged to think of themselves as more adept at scientific or mathematical problems, which may result in them being more task-oriented. Second, insofar as girls are socialized to place a somewhat higher priority on friendship, they may be more concerned with agreeing for the sake of agreeing.

In any event, these results suggest that a more complex model for the effects of peer collaboration on cognitive development may be required.

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PAIRS DID NOT IMPROVE SIGNIFICANTLY MORE THAN INDIVIDUALS

TABLE 1

Mean cognitive change, pairs versus individuals

		Individs (n=41)	Pairs (n=56)	F	p
Treatment	mean	-0.098	0.036	0.25	.616
	SD	(0.89)	(1.69)		
1st posttest	mean	-0.195	-0.107	0.13	.721
	SD	(0.93)	(1.49)		
2nd posttest	mean	-0.054	0	0.05	.827
	SD	(0.85)	(1.49)		

UNEQUAL RULE PAIRS DID NOT IMPROVE SIGNIFICANTLY MORE THAN EQUAL RULE PAIRS

TABLE 2

Mean cognitive change, equal vs. unequal rule conditions

	Equal rule (n=19)	Unequal rule (n=37)	F	p
Treatment mean	-0.316	0.216	1.24	.270
SD	(1.34)	(1.84)		
1st posttest mean	-0.421	0.054	1.29	.260
SD	(1.17)	(1.62)		
2nd posttest mean	-0.316	0.171	1.32	.256
SD	(1.20)	(1.62)		

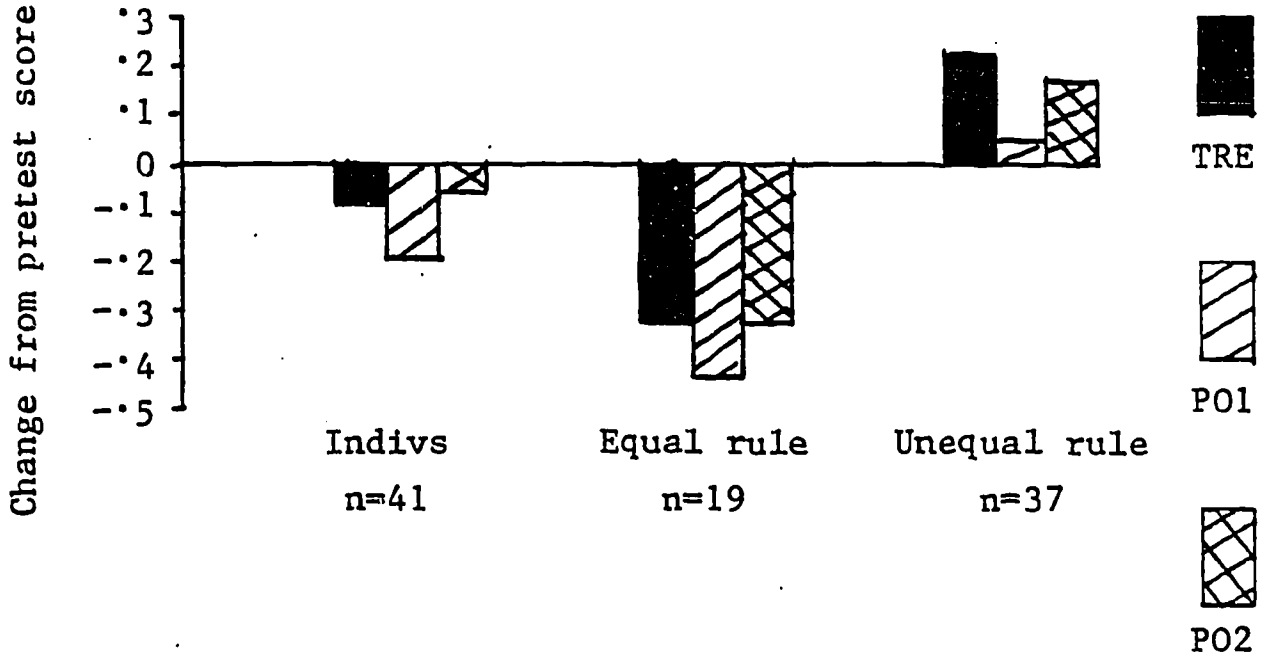

Figure 2: Mean cognitive change, by condition, over time

LOWER PARTNERS IMPROVED MORE THAN HIGHER PARTNERS, WHILE HIGHER PARTNERS DECLINED MORE THAN ALL OTHER CHILDREN

TABLE 3

Mean cognitive change, lower vs. higher partners

		Low partner (n=19)	High partner (n=18)	F	p
Treatment	mean	0.842	-0.722	16.82	.0001
	SD	(0.96)	(1.10)		
1st posttest	mean	0.684	-0.722	13.99	.0003
	SD	(0.89)	(0.99)		
2nd posttest	mean	0.684	-0.647	11.12	.0012
	SD	(0.88)	(1.06)		

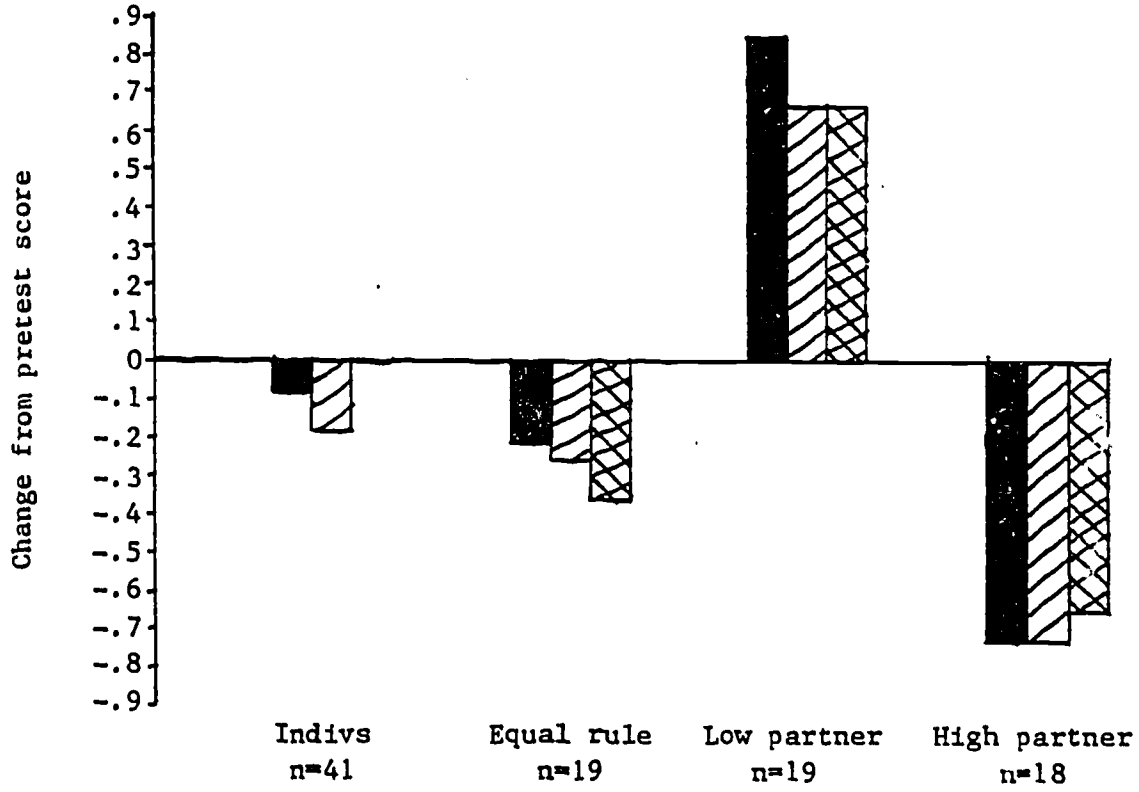

Figure 3: Mean cognitive change, by condition, over time (individuals)

BOYS IMPROVED MORE THAN GIRLS

TABLE 4

Mean cognitive change, by sex, over time

	Girls (n=52)	Boys (n=45)	F	p
Treatment mean	-0.308	0.244	8.36	.004
SD	(0.96)	(1.05)		
1st posttest mean	-0.288	0.044	2.96	.088
SD	(0.87)	(1.04)		
2nd posttest mean	-0.28	0.21	5.92	.017
SD	(0.90)	(1.06)		

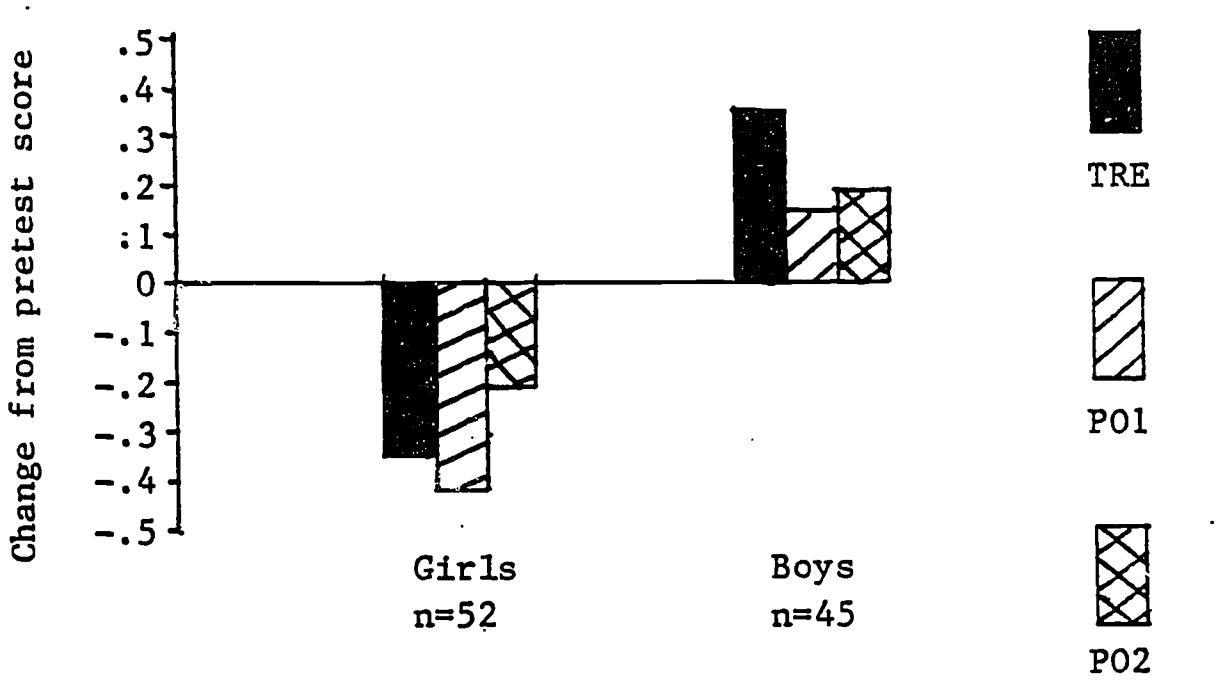

Figure 4: Mean improvement by girls and boys, over time

OLDER CHILDREN IMPROVED MORE THAN YOUNGER CHILDREN

TABLE 5

Mean cognitive change, by age, over time

	Kinder. (n=32)	1st-2nd (n=36)	3rd-4th (n=29)	F	p
Treatment mean	-0.156	-0.167	0.207	6.64	.002
SD	(0.95)	(1.25)	(0.77)		
1st posttest mean	-0.156	-0.222	0	3.41	.037
SD	(0.81)	(1.25)	(0.76)		
2nd posttest mean	-0.194	-0.118	0.179	6.15	.004
SD	(0.98)	(1.20)	(0.72)		

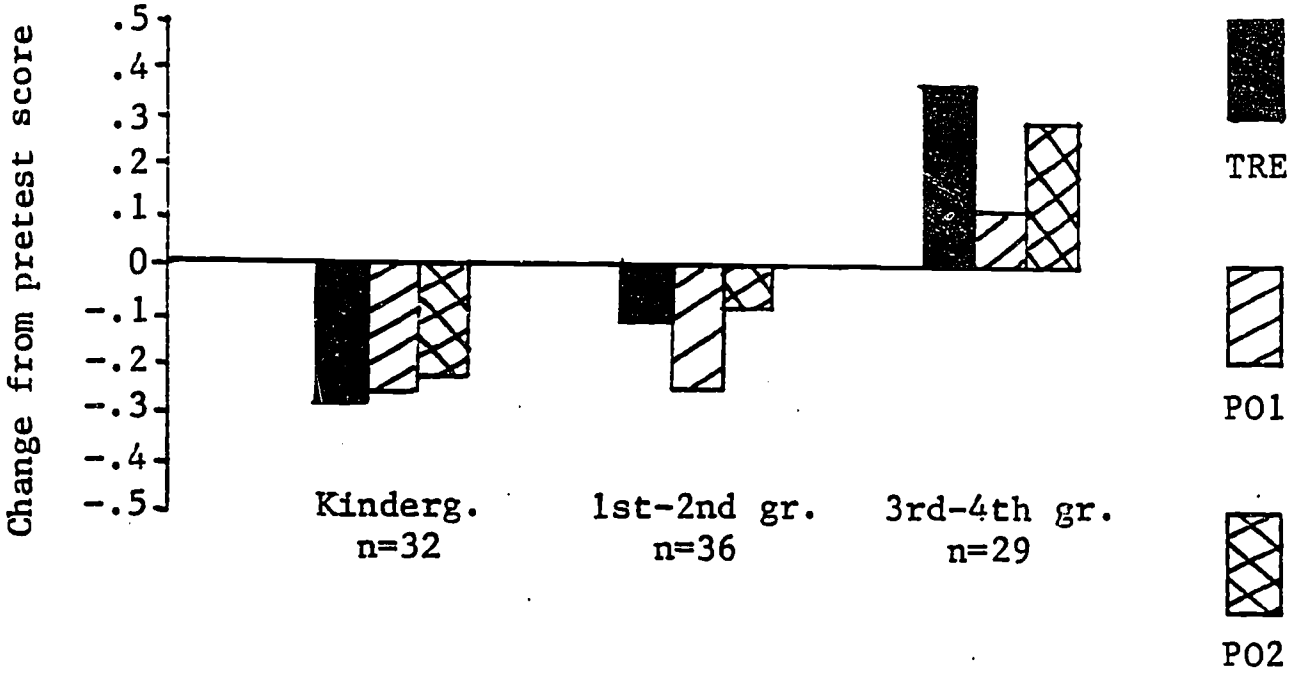

Figure 5: Mean cognitive change, by age, over time

THE INTERACTION OF AGE AND GENDER

TABLE 6

Mean sex differences, at 1st-2nd grade

	Girls (n=17)	Boys (n=17)	F	p
Treatment mean	-0.632	0.353	11.44	.002
SD	(1.01)	(1.32)		
1st posttest mean	-0.632	0.235	9.11	.005
SD	(1.01)	(1.30)		
2nd posttest mean	-0.588	0.353	9.11	.006
SD	(0.94)	(1.27)		

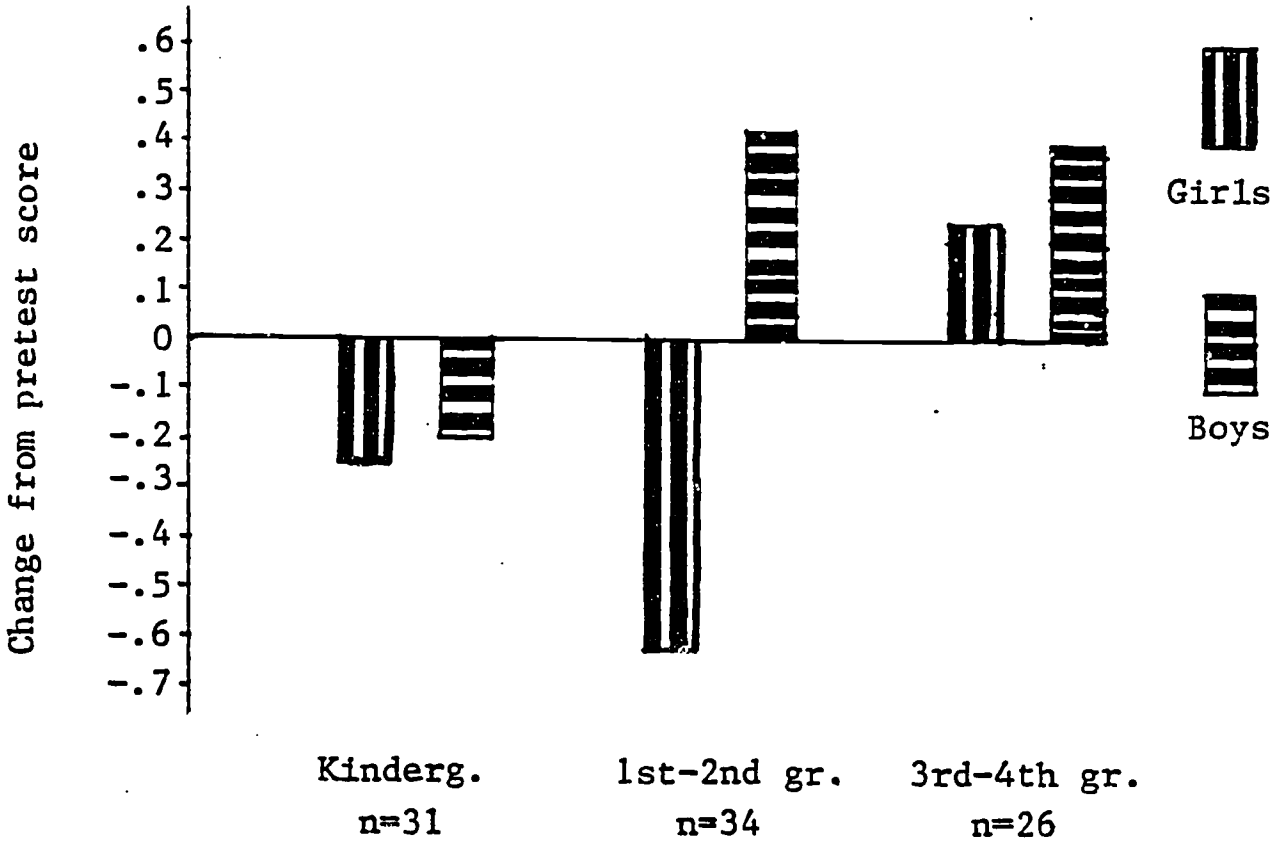

Figure 6: Mean sex differences, by age, at second posttest