The Cognitive and Identity Development of Twins at 16 Years of Age: A Follow-up Study of 32 Twin Pairs

Britta Alin Åkerman and Eve Suurvee

Department of Special Education, Stockholm Institute of Education, Stockholm, Sweden

This is a follow up study of twins within the Stockholm area, including 32 families and their twins attending grade nine. The twins have been followed from birth to 16 years of age. The main purpose of this study from its inception was to assess mental and cognitive development at different ages. Another aim was to see how the twins who were born prematurely are developing during the school ages. A third aim has been to gain a deeper insight into the relationship between co-twins and the development of their identities, which is the focus of this paper. Several ability tests have been used, as well as questionnaires about interests, attitudes toward school, and leisure activities. At the 16-year follow-up, a psychological method, the Wartegg drawing test, designed to examine identity, ego strength, dependency, ambition, anxiety, willpower, creativity, empathy and coping strategies has been used. The results indicate that it is difficult for twins to develop independence and a positive identity, as they have to emancipate themselves both from their parents and from their co-twins. Some differences in identity, anxiety and ambition were observed between female and male twins, MZ and DZ twins, preterm and fullterm twins. Prematurity, sex and zygosity no longer had any relation to cognitive development at 16 years of age.

There has been a steady increase in the number of twins who are live-born all over the world during the last few years. Although many studies have been reported on twins, very few studies have been directed toward the twin situation itself or being a twin parent. Research has shown, however, that unresolved anxieties can affect relationships between parents of twins (Spillman, 1984). These anxieties also may affect the twins themselves and influence their development, especially the development of identity. The mother's insecurity about being a good parent can block her attachment to her twins, make her anxious, and give her the feeling of not being a good mother. This was one of the starting points with the Stockholm twin project concerning the possibility of being able to prevent both developmental problems for the twins and psychological problems for their parents. One focus was to give information to the parents at an early stage on what it actually means to have twins, and on feelings and expectations about their future parenthood (Alin Åkerman, 1987). The connection between one of the authors (BAÅ) and the parents and their twins during the entire study period may have prevented parents from feeling insecure, and increased both their own self-confidence and the positive identity of the twins themselves. The earlier studies of the same twin group have had positive results in some aspects by using psychological tests to assess mental development. The previous results also have shown some differences in cognitive performance between twins and singletons, especially with respect to verbal ability (Alin Åkerman & Thomassen, 1991; Alin Åkerman, 1995). The results from earlier reports also demonstrated that twins are more susceptible to lower birthweight, shorter gestation periods and more birth complications (Alin Åkerman, 1994, 1995, 2002; Alin Åkerman & Thomassen, 1991, 1992).

In order to compare our findings with other studies of a similar nature, several developmental scales have been used. These scales measure general development, and provide information on various aspects of a child's development and capacity for social adjustment. The scale used at 9 months, 18 months, and 4 years of age was the Griffiths' Mental Development Scale (GMDS, Griffiths, 1970). The test includes six subscales for various developmental parameters: locomotor, personal-social, hearing and speech, eye and hand coordination, performance and practical reasoning. The Wechsler Intelligence Scale for Children (WISC, Wechsler, 1991), which consists of a verbal and a performance scale, each having five subtests, was used at eight years of age. Findings from some other studies indicated that twins with low birthweight, most of them born prematurely, showed a lag in cognitive and language development up to 36 months of age (Alin Åkerman & Fischbein 1991; Hay et al., 1987; Watts & Lytton, 1981; Wilson, 1975). Another early focus was to relate the results of the twins' cognitive and language development to teachers' ratings of the twins' adaptation to the school situation.

Several researchers also have discussed whether problems for twins are related to social background. It could be argued that a more stimulating and favorable home environment might reduce, or even eliminate, differences between twins and singletons. Zazzo (1960), Koch (1966), Mittler (1970) and Fischbein (1979) have presented results indicating a difference irrespective of social background. Wilson (1983, 1984) compared twins with low (< 1750g)

Address for correspondence: B. Alin Akerman, Ph.D., Department of Special Education, Stockholm Institute of Education, Box 47308, S-100 74 Stockholm, Sweden. Email: Britta.Alin-Akerman@lhs.se

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and normal birthweight from different social groups. He found that the difference on a mental growth test between low birthweight and other twins was larger in lower social classes and tended to disappear in higher social classes. In a study by Alin Åkerman and Fischbein (1991), it was found that low birthweight (< 2.5 kg) seemed to have a lasting impact on mental development up to 18 years of age. In particular, twin boys with low birthweight seemed to be at a disadvantage. This difference tended to disappear, however, in a more stimulating home environment. Relating social background to the study in this paper, we found that most families live under good socioeconomic circumstances with satisfactory economy and housing. No single mothers were included (Alin Åkerman, 1987).

Studies during adolescence, with a focus on identity, have shown that this period can be more difficult for twins than for singletons (Fischbein, 1979). In our 13-year follow-up study it was found that twins had very close bonds with each other, which made it difficult for them to develop a feeling of identity (Alin Åkerman, 2003). It also was found that the process of liberation often resulted in violent fights and controversies between co-twins. If puberty occurred at different times for co-twins, problems resulted both for the twins themselves and for their parents. This often occurred for DZ twins, influencing their self-image and identity.

The aim of this paper is to provide results at 16 years of age to determine if there are any cognitive differences between, (i) male and female twins, (ii) MZ and DZ twins, (iii) preterm and fullterm twins, and (iv) if there are differences in identity: for example, in self-esteem, activity, dominance, and similar attributes between female and male twins, MZ and DZ twins, preterm and fullterm twins. Self-esteem, activity and dominance are personality traits, which influence the development of identity.

Method

Participants

This study was carried out at the Women's Clinic of the Karolinska Hospital in Stockholm, Sweden where, since 1980, there has been a special interest in twin pregnancies. The same obstetrician was in charge of all pregnancies. Ultrasonic observation and other medical checkups of the mothers and the fetuses took place at regular intervals every four months after the twin diagnosis. The group consisted of both first-time parents (n = 16) and parents who already had children (n = 19). Six pregnancies resulted from assisted fertility procedures. After the twin birth, eight families gave birth to a singleton child.

Contact with the families and their twins was made at birth, 9 months, 18 months, 4 years, 8 years, 13 years, and 16 years of age. The first contact with the families was made between December 1981 and July 1983. The group was composed of 35 pairs of parents-to-be and, later, their twins. All women diagnosed to be pregnant with twins were included.

At present there are 32 twin pairs; one twin was stillborn and two families left the country and have not been located. Thirteen twin pairs are MZ and 19 twin pairs are DZ. Thirty-five are females and 29 are males. Twenty-six twins were born preterm and 38 were born fullterm (> 37 weeks). Six children were born with physical handicaps. None of the twins had any sign of cerebral injury. Most families live under good socioeconomic circumstances. Postnatally, zygosity was determined by examination of placentas and membranes in all like-sexed twins. In those 9 pairs who were neither monochorionic, as a sign of monozygosity, or of different sex, as a sign of dizygosity, blood group tests were used to establish zygosity.

Developmental Tests

At 13 and 16 years of age, three ability tests, constructed by Härnqvist and Svensson (Härnqvist, 1968), measuring verbal (opposite), spatial (metal folding), and numerical (number series) abilities were used. These tests have shown a high degree of consistency (Emanuelsson & Svensson, 1990).

In the current study, for the verbal test, the 16-year-olds had to find the opposite of a given word among four alternatives. There were 40 items to be completed in ten minutes.

In the metal folding test, the respondent had to find the three-dimensional object among four alternatives that can be made from a flat piece of metal with bending lines marked on the drawing. There were 40 items to be completed in 15 minutes.

In the number series test, the respondent had to complete a number series, of which six numbers are given, with two more numbers. There were 40 items to be completed in 18 minutes.

Psychological Tests

To measure self-confidence, self-esteem, social relations, relations to peers and parents, ambitions, power and energy, anxiety, handling of conflicts, defense mechanisms, empathy and aggression (all are part of identity), a psychological method known as the Wartegg drawing test was used. This test also provides information about creativity, accuracy, patience, and impulsiveness. The test was developed in Germany during the 1930s and is used in many countries in Europe and South America, as well as in Canada (Crisi, 1998; Gardziella, 1985). A Swedish study, with the aim to examine the validity and reliability of the test, showed an inter-rater agreement of 77.5% of all estimations, considered to be a sufficient reliability (Wass & Mattlar, 2000). The test material also has shown good clinical power to describe depression in singletons during adolescence (Alin Åkerman, 2002). The test consists of a paper with eight squares, four centimeters across each edge, in which dots and lines are painted. One of them is a single dot, one consists of several dots making a half circle, and some are small straight lines in different combinations. The twins were asked to complete the incomplete squares in any way that they wanted and in whichever order they wanted. After completing the entire test, they were asked to describe what their pictures meant. Both the pictures and the verbal description were the basis for interpretation. To do this blindly, the results were sent to one of the authors of this paper (ES) who knew the twins only as pairs, as well as their age and gender, before interpretations were made. After the interpretations, the group was divided into smaller groups to examine possible differences between male and female twins, MZ and DZ twins, and preterm

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and fullterm born twins. A blind analysis (i.e., the test interpreter did not know anything about the groups) was very important, as knowledge about the twins' backgrounds and the cognitive results could easily influence the interpretation of the pictures.

Wartegg drawing test results are given for 55 twins (32 females and 23 males). Six twins agreed to take the cognitive test but not the Wartegg. One twin is severely mentally retarded and could not do any of the procedures or tests.

No matched control group has been used to compare the cognitive results between the twins and singletons. But comparisons have been made with three different Swedish studies using the same method and age groups to collect data. Up to 4 years of age a study of Nordberg (1994) was used. At 8 years of age a study of Andersson (1989), and for the last two test periods a study of Emanuelsson and Svensson were used (1990).

Results

Statistics

Two-sample unpaired *t* tests of group differences were used in all comparisons where the ability tests were examined. Statistical significance was set at the .05 level. The data from the Wartegg drawing test cannot be analyzed statistically, but only presented descriptively.

Table 1 shows the ability test scores for male and female twins at 16 years of age. The comparisons between scores for MZ and DZ twins are presented in Table 2. The results comparing preterm and fullterm twins are shown in Table 3.

At 16 years of age there were no significant differences between male and female, MZ and DZ, and preterm and fullterm twins.

Correlational analyses were computed between the cognitive and ability test scores at the different ages. The results are presented in Table 4.

There were significant, predictive correlations from four years of age and older to 16 year assessments. The Griffiths language did not predict until 4 years of age, where only the 16-year verbal and number series tests were predicted. All 8 and 13 year tests were significantly correlated with the 16-year tests.

Psychological Tests

To examine the results from the Wartegg drawing test, the following could be discerned. It is important to note, however, that these results only can describe a tendency for this twin group and must be interpreted with caution. Results have been determined for these different groups by examining tendencies for twin boys compared to twin girls, MZ and DZ twins, unlike-sex twins compared to same-sex twins, and preterm twins compared to fullterm twins.

Table 1

Ability and Achievement Test Scores for Male and Female Twins

	male			female			*t* score	
	N	$\bar{X}$	*SD*	*N*	$\bar{X}$	*SD*		
Verbal	29	27.5	4.8	35	27.3	7.7	0.11	*ns*
Spatial	29	27.4	6.4	35	27.3	4.7	0.01	*ns*
Number series	29	28.1	7.8	35	28.8	7.8	0.40	*ns*

Note: *ns* = non significant

Table 2

Ability and Achievement Test Scores Related to Zygosity

	MZ twins			DZ twins			*t* score	
	N	$\bar{X}$	*SD*	*N*	$\bar{X}$	*SD*		
Verbal	26	28.4	7.7	38	26.7	5.6	0.99	*ns*
Spatial	26	26.9	4.9	38	27.6	5.9	0.50	*ns*
Numerical	26	29.6	7.8	38	27.7	7.6	0.97	*ns*

Note: *ns* = non significant

Table 3

Ability and Achievement Test Scores Related to Preterm and Fullterm

	Preterm twins			Fullterm twins			*t* score	
	N	$\bar{X}$	*SD*	*N*	$\bar{X}$	*SD*		
Verbal	26	27.7	4.4	38	27.3	7.7	0.30	*ns*
Spatial	26	27.4	6.5	38	27.3	4.8	0.10	*ns*
Number series	26	26.7	6.9	38	29.7	8.2	1.52	*ns*

Note: *ns* = non significant

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Table 4

Correlation Matrix Between Earlier Data and Data for the 16-year Follow-up Study

	Verbal 16 years	*p*-value	Spatial 16 years	*p*-value	Number series	*p*-value
Griffiths language 9 months	.121	.3473	.026	.8409	.167	.1918
Griffiths language18 months	.219	.0849	.054	.6757	.119	.3557
Griffiths language 4 years	.574	<.0001	.207	.1038	.332	.0075
Griffiths total 4 years	.531	<.0001	.308	.0136	.459	.0001
Wechsler, verbal, 8 years	.716	<.0001	.344	.0055	.490	<.0001
Wechsler, perform, 8 years	.512	<.0001	.553	<.0001	.509	<.0001
Wechsler, total, 8 years	.705	<.0001	.453	.0002	.582	<.0001
Verbal 13 years	.768	<.0001	.343	.0056	.554	<.0001
Spatial, 13 years	.343	<.0056	.647	<.0001	.261	.0386
Number series, 13 years	.589	<.0001	.462	.0001	.787	<.0001

Some of the subgroups were too small. No tables or quantitative data can be provided due to the small number of individuals in every subgroup.

When comparing the Wartegg results for twin boys and girls, boys put themselves first in relationships to a higher degree than did girls. Boys think more about their own needs and wishes, but girls think more about other people's demands and wellbeing and put themselves second. Twin boys also put themselves in a hierarchical system more frequently, and were more dependent on rules than girls, whose intentions are for more equal relationships in a more democratic way, with no wish to exercise power over others. The twin girls, especially the MZ girls, were symbiotic with each other, which was not seen for the twin boys who, due to their less symbiotic behavior, seemed to have a better ability to relate to peers than did the twin girls.

Boys in unlike-sex pairs had more self-respect and self-confidence than boys in same-sex pairs. The unlike-sex boys also were less critical of themselves and other people, which is a positive factor in relations with peers and adults. The six boys from unlike-sex pairs were very ambitious, a trait not seen for the boys in same-sex pairs. In relation to a very active sister, the brothers acted as a "younger brother", for example, very conformed, well behaved, and nice.

The unlike-sex girls were more gender differentiated than the same-sex girls. The former gave more feminine answers and seemed to cope with their aggressive power in a better way. They also had a better ability to relate to others, not in a symbiotic manner, compared to same-sex twin girls. In contrast, the ambitions of unlike-sex girls were more unrealistic than those of same-sex girls. Unlike-sex girls had goals that were too high to be realistic in relation to their competence. In other words, they were too optimistic to accomplish their goals.

MZ twin boys, compared to DZ boys, expressed their aggressive behavior in a more inhibited way. Their behavior was filled more with anxiety in representation of aggressive behavior. They were less emphatic and did not show the softer emotional parts of their behavior compared to DZ boys. DZ boys, on the other hand, could cope with their anxiety in a more constructive way, and also were more creative.

The MZ twin girls were more guarded (cautious), retiring, and controlled, and tried to be more well-behaved compared to the DZ girls. The latter were more powerful, creative, expansive, and demanding of more space, meaning that they took up a great deal of psychological space. DZ girls also were more aggressive, energetic and ambitious. Their self-esteem and self-confidence were greater compared to the MZ girls.

When comparing preterm and fullterm twins, some interesting results were found. The preterm twin girls did not defend themselves by their own power, and they also often sought protection from others. One of the twins usually protected the other and was herself very dependent on her twin sister. These girls had developed some negative psychological defenses or had a more repressed emotional life. They had more unrealistic ambitions and their relations to others were not well developed. One sister's role was to be more active and more independent, and to take care of her twin sister, while the other was more passive, dependent, and let the sister take care of her. Similar differences were not observed for fullterm twin girls. The fullterm twins had a tendency to evaluate themselves in a more positive way than the preterm twins. One fullterm twin of a pair had a tendency to take a more dominant role, and the other a more submissive role. This difference was not observed within the preterm twin pairs.

Preterm twin boys had more serious psychological problems than fullterm twin boys, such as inhibited activity and a higher degree of anxiety. The preterm boys were more psychologically immature. Some of these test results are similar to those obtained from normally developed 6–7 years old boys (Alin Åkerman, 2002). The preterm twin boys also were more guarded and afraid of opposition. But preterm twin boys in unlike-sex pairs displayed or expressed more apparent ambitions about education and a hope for their future occupation than did unlike sex preterm twin girls.

Discussion

This group of twins has been followed for 16 years, which is quite unusual in twin studies. A great deal of effort has been made to maintain contact with the twins from birth to adolescence. Still, almost the entire group has been

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included at 16 years. All participating families, including parents and their twins, were highly anxious to be part of the study, which probably motivated them to solve the ability tests as best as they could and also to answer all questions willingly about their being a twin. The results from the interviews are available elsewhere (Alin Åkerman, 2003).

Significant results of the study are the strong longitudinal correlations, demonstrating the ability to use the early tests to provide some prognosis of future performance and abilities, and suggesting when special support may be necessary for children who have not scored well. As soon as a test indicates cognitive difficulties for twins, it is important to help these twins catch up just to avoid a later failure. It also is very important to give the family support both during the pregnancy and throughout the twins' development. With this support, the family can strengthen their children's total development.

The 16-year assessments did not demonstrate group differences in the cognitive measures based on sex, zygosity, or term at birth. Previous studies of this twin group, however, showed that twin girls performed much better than twin boys at 9 and 18 months of age, as well as at 4 and 8 years of age (Alin Åkerman, 1987, 1994; Alin Åkerman & Thomassen, 1991, 1992). The results from the cognitive tests were higher for twin girls than for twin boys from 9 months of age up to 8 years of age, similar to findings for singleton girls compared to singleton boys up to 4 years of age (Nordberg, 1994). At 4 years, MZ twins performed significantly better than DZ twins (Alin Åkerman & Thomassen, 1991), but this difference disappeared at eight years. At 8 years of age it was observed that, of six of the nine unlike-sex twin pairs, boys performed less well than girls, irrespective of term (Alin Åkerman, 1995). At age 13 there were no significant differences between males and females (Alin Åkerman, 2003). Comparisons with singletons at the same age as the twins and using the same assessments indicated that, at 16 years of age, there was a tendency for lower results for the twins than for the singletons on numerical ability (Emanuelsson & Svensson, 1990).

The long-term importance of prematurity for the development of twins has not been clarified by other studies. Prognosis for children born preterm (< 38 gestational week) has been studied in other investigations (Fitzhardinge, 1976; Neligan et al., 1976), but those studies had short follow-up periods, and emphasized neurological handicaps. A separate investigation of future consequences of birth complications for twins indicated a lasting impact of those complications on mental development for the prematurely born twins at 18 years of age (Alin Åkerman & Fischbein, 1991).

The findings for this Stockholm sample have shown that prematurity was meaningful at each testing period up to 13 years of age, but not at 16 years of age. In the 13-year follow-up, moreover, of the 64 twins, 20 had some problems in their school situation. Almost all of those who had either been born preterm, or weighed less than 2500g at birth were in this group of poor performers (Alin Åkerman, 2003). Parental reports obtained while the twins completed the tests indicated that parents feel that, the more the environment stresses the independence of adolescents, the more the parents could anticipate that their twins had developmental problems, especially MZ and preterm twins. Advice from the examiner may have helped parents cope with problem situations.

To summarize, at 16 years of age, there no longer were group differences in cognitive development. The preterm twins compared to the fullterm twins, and the boys compared to the girls, overcame the lag in cognitive achievement that had been seen up to 13 years of age. Thus, the higher-risk twin has caught up with the lower-risk co-twin.

No previous research with twins using the Wartegg method has been found, although the Wartegg method has been used in several studies with singleton children and adolescents. By using this method, interesting results about differences in identity for the twin group was found.

At first it is important to emphasize that the twins' development is connected intimately with how well their emotional development has matured. Their identity development also will compete with their cognitive development (Alin Åkerman, 2003). As we know, much logical thinking and reflection require emotional input. When a youngster does not feel safe and independent, he/she does not want to use creative thinking, but can be skilled at rote learning. If the child feels safe and also can cope with different frustrations and difficulties in associating with classmates and learning situations at school, better methods of problem-solving will be achieved. To develop a good identity also means to be capable of deep thinking. This means that cognitive training alone is not always sufficient, but that emotional development has to be considered as a determining factor for how far a student can develop cognitively.

This study has shown that positive identity is influenced by the twins' disparity in sex, zygosity, and term at birth. Use of the Wartegg drawing test has shown that positive identity is strongest for DZ twins, both unlike and same-sex pairs. Identity has more negative components for the MZ twins. The differences affect the separation and individuation within twin pairs. The first glance would suggest that there are bigger problems for the boys as they exhibit more aggressive behavior. Twin girls are calmer, but this calmness could be an effect of insufficient ego strength and individuation. MZ twin girls especially have problems with their identity. They are too dependent on their twin sisters, and their parents are less important for them compared to the DZ twins.

Finally, it is important to emphasize that the results from the Wartegg drawing test have been the same as the results from meetings and communications with the twins. The interview contact, however, is more subjective and can be influenced easily from the earlier meetings with the twins. The use of a projective test, the Wartegg drawing test, and having it interpreted by a psychologist who either does not know, or has not seen, the twins, decreases subjectivity and has, in this twin study, confirmed the observations and interviews with the twins.

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