PSYCHOLOGICAL FOLLOW-UP STUDY OF TWINS FROM BIRTH TO FIVE YEARS*

W. DE COSTER, J. LEROU, C. DUTOIT, M. DE ZUTTER,
R. DEROM, M. THIERY, A. VANDIERENDONCK
Departments of Psychology and of Obstetrics, University of Ghent, Belgium

Classical psychological twin studies have yielded in part equivocal and sometimes contradictory results. Besides the complexity of the problem, the delicate character of the diagnosis, and the rudimentary tools which were used, several other factors are underlying this situation: (1) insufficient systematization of the set-up and the careless design of the investigations; (2) lack of follow-up studies; (3) uncertain diagnosis of zygosity; in MZ twins no attention to the age of the ovum at the time of cleavage; (4) lack of consideration for antenatal and perinatal influences; (5) no attention to the typical circumstances linked to the twin situation. All this makes it difficult to balance nature against nurture on the basis of comparison between MZ twins, DZ twins, and singletons. Interactions may also appear between the effect of twinning and other factors such as the socioeconomic circumstances. A new investigation was therefore started where, besides the twins, a group of matched control singletons was constituted. The follow-up study is now completed up to the age of 5 years in 13 MZ and 20 DZ twin pairs (+ controls, that is to say, 99 children).
The children were observed and subjected to psychological tests at the age of 6 months and of 1, 2, 3, 4, and 5 years.

INTRODUCTION

Classical psychological studies of twins have too often yielded equivocal and contradictory conclusions. The complexity of the problem, the difficulty of diagnosing zygosity correctly, and the rudimentary tools available, readily explain this situation. However, there is a set of ancillary factors which have unquestionably biased the results of many studies. Among these factors are the following:

1. Careless research design.

2. The absence of a follow-up permitting investigation of the evolution of the phenomena and taking into account at each level, a series of antecedents registered in the course of the study. Because the relationship between the factors involved (nature and nurture) may differ according to age level, follow-up studies are mandatory. Moreover, follow-up studies offer an excellent opportunity to check the predictive validity of the evaluation techniques used.

3. Confusion between correlational and causal relationships.

4. Insufficiently systematic series of hypotheses and alternative hypotheses, with almost no inclusion of alternative relationships.

* *List of abbreviations and symbols.* DQ: developmental quotient (Bühler-Hetzer Entwikkelungstest); BH and BH scale: Bühler-Hetzer developmental scale; LIPS: Leiter International Performance Scale; IQ: level of intelligence; MZ: monozygotic twin; DZ: dizygotic twin; DZ = : DZ of same sex; DZ≠ : DZ of different sex; TW: twin; WPD: within-pair differences; SENS: sensory development; MOTOR: motor development; SOC: social adaptation; LE: learning; MATER: handling of materials; INT: intelligence; and LANG: language.

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5. Insufficient attention to the age of the ovum at the time of cleavage.

6. Lack of consideration of antenatal and perinatal fetal influences.

7. Neglect of possible differences in reaction to stimulation according to age level, and of the fact that the results are not transferable from culture to culture. Some controversial results might be explained, for example, by the fact that children are particularly sensitive to environmental influences between the age of 2 and 5. This might, in fact, be extremely important in certain cultural settings in which such influences are exerted strongly, whether consciously or unconsciously. It is even possible that at the age of 8, given a minimum of environmental stimulation, constitutional capacities and tendencies again become dominant.

8. Neglect of typical environmental circumstances linked to the twin situation implying that singletons, MZ twins, like-sexed DZ twins, and DZ twins of different sex may be subject to divergent influences, different degrees of pressure in the direction of identity development, and so on.

As a result of such factors, comparison both of singletons and twins and of twins belonging to the various groups may become almost impossible. The typical circumstances characterizing the twin situation can influence, for example, the development of self-concept, self-image, language, etc., with repercussions on intelligence, motivation, and personality. As a matter of fact, family influences on strongly identical MZ twins probably contribute to greater equalization and lack of individual identity between partners. The effect of the family on DZ twin partners, who may differ from each other somatically, psychologically, and in sex, can be divergent. Interactions may appear between the type of twinning and environmental circumstances. However, our data and the criteria applied for evaluating environmental circumstances do not permit the demonstration of such differences in family attitudes for the partners of the various groups of twins included in our investigation.

MATERIALS AND METHODS

Because of the biases mentioned, we designed a new kind of investigation. At present, follow-up study covers the period up to the age of 5 for 13 MZ and 20 DZ pairs, a total of 66 twins*. They were observed and given psychological tests at 6 months and again at 1, 2, 3, 4, and 5 years of age.

At these age levels a slightly modified *Bühler-Hetzer Entwicklungstest* was administered. This test gives information on sensory and motor development, social adjustment (socialization), learning, skills (handling materials), and intellect, summarized in a global developmental quotient. Language performance was assessed by summing all language items of the BH. Meanwhile, our laboratory has been preparing a new developmental test for babies and preschoolers. Care is taken to obtain a calibrated instrument meeting the requirements concerning validity and methodology. In addition, our study is based on the most recent thinking in this field, so that the test will yield results reflecting actual and local circumstances. The problems raised by the use of the BH test — temporarily applied in our twin studies — systematically reminds us to avoid artifactural results caused by nonrepresentative item sampling and unsuitable methods of data reduction. Thus, it has been found that at the age of 2 years some of the items of the modified BH scale are not representative, which results in low scores on the subtests measured in « genetic days », as well as for the overall DQ score. As a consequence, within-pair differences are also rather low. On the other hand, it should be borne in mind that at certain ages some items are either no longer or not yet critical, so that these ages are represented by too few typical items, which means that, at these ages the test is not sufficiently discriminatory.

The test was administered in the home environment. This offers the opportunity to interview the parents and observe the behavior of the children as well as the mother's attitude toward her child.

From the age of three on, information was also gathered from the nursery-school staff concerning children attending such schools. From the age of four on, we added testing with the *Leiter International Performance Scale*, which yields a « level of intelligence ». In previous studies this instrument had been found to be much less sensitive to envinronmental influences than most of the other available intelligence tests.

For all tests and subtests, the data analysis was based on the mean score of each twin pair. Statistical analyses of the material were based on analyses of variance techniques. Only differences between means that reached the 0.05 level of significance were retained as « real » differences. Nonsignificant results are, however, more often than not found to point in the same direction as the significant ones.

* For the younger age groups the number of subjects is already much larger.

Table 1. *Means, F-ratio, and levels of significance of the Bühler-Hetzer Scale and the LIPS for MZ and DZ twins*

Age	DQ (BH)		IQ (LIPS)		SENS		MOTOR	
	MZ	DZ	MZ	DZ	MZ	DZ	MZ	DZ
6m.	106.8	98.7			173.3	171.2	200.1	196.3
$df_1 = 1$ $df_2 = 77$	$F = 1.19$				$F = 0.24$		$F = 0.75$	
1y.	106.9	106.8			441.5	440.4	398.8	395.9
$df_1 = 1$ $df_2 = 67$	$F = 0.00$				$F = 0.09$		$F = 0.02$	
2y.	95.5	98.2			664.8	639.3	699.2	700.6
$df_1 = 1$ $df_2 = 49$	$F = 0.46$				$F = 0.69$		$F = 0.00$	
3y.	95.4	106.2					1062.9	1123.2
$df_1 = 1$ $df_2 = 44$	$F = 7.33$**						$F = 0.78$	
4y.	99.3	107.1	92.5	102.8			1376.4	1425.0
$df_1 = 1$ $df_2 = 39$	$F = 4.88$*		$F = 3.78$				$F = 2.41$	
5 y.	101.4	103.2	95.8	101.9			2104.6	1908.0
$df_1 = 1$ $df_2 = 31$	$F = 0.30$		$F = 1.13$				$F = 3.33$	

Notes. Levels of significance are indicated as follows: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$. The first and second columns contain DQ and IQ means, respectively. All subtests of the BH scale, except « language » which overlaps with the others, are expressed in genetic days. The language subtest is measured as the number of language items passed.

RESULTS AND CONCLUSIONS

Although only preliminary conclusions can be drawn from our material, the data throw some light on several of the specific problems involved. With one exception, i.e., that some of our results are not statistically significant, they agree with those produced by other investigators such as Zazzo (1960), Koch (1966), and Vandenberg (1968). These results can be summarized as follows:

1. As far as the general level of psychomotor development is concerned, DZ twins tend to perform significantly better than do MZ twins, but only at the ages of three and four ($p > 0.01$ and > 0.05, respectively). With respect to social adjustment and language performance, DZ twins score significantly higher than MZ twins ($p > 0.025$ to 0.01) (Table 1). These results are partially in agreement with the findings of Zazzo (1960), Koch (1966), Vandenberg (1968), and others.

Subtests Bühler-Hetzer Scale									
SOC		LE		MATER		INT		LANG	
MZ	DZ	MZ	DZ	MZ	DZ	MZ	DZ	MZ	DZ
193.6	193.7	182.6	182.5	199.9	206.4				
$F = 0.00$		$F = 0.00$		$F = 0.63$					
419.1	415.7	357.9	348.9	344.9	360.8	383.4	383.6		
$F = 0.03$		$F = 0.45$		$F = 0.81$		$F = 0.00$			
722.0	751.3	579.9	555.0	781.4	824.5	646.4	659.5	0.7	1.0
$F = 0.43$		$F = 0.440$		$F = .68$		$F = 0.10$		$F = 2.42$	
1017.1	1168.2	932.2	1023.6	1305.7	1285.2	1092.9	1209.6	2.6	3.6
$F = 7.80^{**}$		$F = 3.47$		$F = 0.07$		$F = 3.45$		$F = 6.78^{*}$	
1500.6	1632.5	1228.3	1340.0	1678.3	1710.0	1569.7	1676.3	4.5	5.0
$F = 3.72$		$F = 1.94$		$F = 0.24$		$F = 3.36$		$F = 1.12$	
1818.5	1909.5	1601.5	1692.0	1980.0	1011.5	1938.5	2070.0	6.5	6.9
$F = 2.29$		$F = 1.98$		$F = 0.62$		$F = 2.48$		$F = 1.47$	

2. Comparison of MZ twins, like-sexed DZ twins and DZ twins of different sex (Table 2), shows that:

2.1. For the general level of psychomotor development, the three groups differ significantly at the ages of 3 and 4 ($p > 0.001$).

2.2. For intelligence, a very significant difference is found at the age of 4 ($p > 0.001$).

2.3. For the various aspects of the BH scale: significant differences appear for social adjustment and language at the ages of 2, 3, 4, and 5 ($p > 0.05$ to 0.001); for learning and intelligence at the ages of 3, 4, and 5 ($p > 0.025$ to 0.001); and for motor development at the age of 2 ($p > 0.05$).

2.4. DZ = twins perform significantly than DZ≠ twins at the age of 2 for language ($p > 0.01$); at the age of 3 for general level of psychomotor development, social adjustment, intelligence (BH), and language ($p > 0.05$); at the age of 4 for DQ, general level of psychomotor development, IQ, social

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Table 2. *Means, F-ratio, and levels of significance for MZ, DZ= and DZ≠ twins*

Age	DQ (BH)			IQ (LIPS)			SENS			MOTOR		
	MZ	DZ=	DZ≠	MZ	DZ=	DZ≠	MZ	DZ=	DZ≠	MZ	DZ=	DZ≠
6m.	107	98	99				173	170	174	201	200	197
$df_1 = 2$ $df_2 = 76$		$F = 0.59$						$F = 0.57$			$F = 0.41$	
1y.	107	110	104				442	431	450	399	392	400
$df_1 = 2$ $df_2 = 66$		$F = 1.34$						$F = 1.75$			$F = 0.15$	
2y.	95	101	94				665	633	647	699	734	659
$df_1 = 2$ $df_2 = 48$		$F = 2.60$						$F = 0.69$			$F = 3.98$*	
3y.	95	110	99							1063	1176	1044
$df_1 = 2$ $df_2 = 43$		$F = 11.20$***									$F = 2.74$	
4y.	99	113	101	92	112	93				1376	1425	1425
$df_1 = 2$ $df_2 = 38$		$F = 14.69$***			$F = 14.56$***						$F = 2.09$	
5y.	101	106	100	96	106	96				2105	1931	1880
$df_1 = 2$ $df_2 = 30$		$F = 2.37$			$F = 3.01$						$F = 3.17$	

Notes. See Table 1.

adjustment, learning and intelligence (BH) ($p > 0.05$ to > 0.01); and at the age of 5 for learning only ($p > 0.025$).

2.5. DZ = twins perform significantly better than MZ twins on several scores: at 2 years for language ($p > 0.025$); at 3 years for DQ, social adjustment, intelligence (BH), and language ($p > 0.025$ to 0.001); at 4 years for social adjustment, learning, and intelligence (BH) ($p > 0.025$ to 0.001); at 5 years for social adjustment, learning, and intelligence (BH) ($p > 0.025$ to 0.05).

Roughly speaking, these results indicate that there are real differences in several aspects between the various types of twins. Moreover, there is a tendency for the DZ = twins to score better than MZ and DZ≠ twins, and for the MZ twins to score better than DZ≠ twins, although the latter differences do not reach significance. These results, too, agree with the findings of Koch (1966) and Zazzo (1960), who also mention that MZ twins achieve less than DZ twins of different sex. However, this difference did not appear to be significant in our material. At any rate, it is not easy to interpret these results correctly. Among the differences observed at any given age level, there was no significant diver-

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Subtests Bühler-Hetzer Scale															
SOC			LE			MATER			INT			LANG			
MZ	DZ=	DZ≠	MZ	DZ=	DZ≠	MZ	DZ=	DZ≠	MZ	DZ=	DZ≠	MZ	DZ=	DZ≠	
194	198	187	182	184	181	200	207	207							
	$F = 0.37$			$F = 0.02$			$F = 0.31$								
419	422	409	358	353	344	345	365	356	383	396	370				
	$F = 0.31$			$F = 0.73$			$F = 0.89$			$F = 2.27$					
722	794	699	580	557	553	781	806	847	646	689	623	0.7	1.3	0.6	
	$F = 3.30^{*}$			$F = 0.39$			$F = 1.03$			$F = 1.72$			$F = 11.40^{***}$		
1017	1224	1084	932	1056	975	1306	1278	1296	1093	1278	1107	2.6	3.9	3.0	
	$F = 9.91^{***}$			$F = 4.07^{*}$			$F = 0.08$			$F = 7.08^{**}$			$F = 8.89^{***}$		
1500	1715	1500	1228	1445	1235	1678	1747	1672	1570	1766	1586	4.6	5.6	4.5	
	$F = 7.73^{**}$			$F = 6.88^{**}$			$F = 1.09$			$F = 10.74^{***}$			$F = 5...07^{*}$		
1818	1964	1834	1601	1778	1587	1980	2045	1970	1938	2156	1965	6.6	7.3	6.6	
	$F = 4.79^{*}$			$F = 8.84^{***}$			$F = 2.97$			$F = 5.95^{**}$			$F = 4.41^{*}$		

gence for sensory development or the handling of materials (see also Table 3).

3. Up to the age of 3, within-pair differences in social adjustment were found to be significantly larger in DZ than in MZ twins ($p > 0.05$). Furthermore, we found DZ twins to differ significantly more than twins for general level of psychomotor development at 6 months ($p > 0.025$), for motor development at 1 year ($p > 0.01$), and handling materials at 1 and 3 years ($p > 0.01$) and $p > 0.025$). For the other aspects investigated (intelligence, sensory development, and language), within-pair differences were not significantly different for MZ and DZ twins (Table 3).

4. Concerning the comparison of within-pair differences between MZ twin-partners, like-sexed DZ twin partners, and DZ twin partners of different sex (Table 4), the following may be said:

4.1. For the general level of psychomotor development, the three groups differ significantly at 6 months, 3, 4, and 5 years (from $p > 0.05$ to $p > 0.01$). Only at the age of 4 is a significant difference found between DZ = and DZ≠ twins (DZ≠ > DZ =; $p > 0.025$).

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Table 3. *Means, F-ratio, an levels of significance for within-pair differences of MZ and DZ twins*

Age	DQ (BH)		IQ (LIPS)		SENS		MOTOR	
	MZ	DZ	MZ	DZ	MZ	DZ	MZ	DZ
6m.	4.8	9.4			3.3	8.4	11.6	18.0
$df_1 = 1$ $df_2 = 77$	$F = 6.09$*				$F = 3.00$		$F = 2.80$	
1y.	10.1	10.5			29.0	16.2	16.5	51.6
$df_1 = 1$ $df_2 = 67$	$F = 0.01$				$F = 1.12$		$F = 9.93$	
2y.	4.6	4.9			4.1	6.2	42.9	51.2
$df_1 = 1$ $df_2 = 49$	$F = 0.10$				$F = 0.12$		$F = 0.06$	
3y.	6.5	10.8					137.1	144.0
$df_1 = 1$ $df_2 = 44$	$F = 4.01$						$F = 0.01$	
4y.	4.2	6.2	15.5	10.7			0.0	30.0
$df_1 = 1$ $df_2 = 39$	$F = 1.97$		$F = 1.35$				$F = 1.47$	
5y.	4.3	5.5	12.5	12.9			55.4	0.0
$df_1 = 1$ $df_2 = 31$	$F = 0.42$		$F = 0.01$				$F = 1.57$	

Notes. Levels of significance are indicated as in Table 1. Numerical values are mean differences between the scores of both twin partners. The meaning of the scores is identical to that in Table 1.

4.2. For intelligence (LIPS), too, the three groups differ significantly at the age of 5 years ($p > 0.05$).
4.3. For the various aspects, significant differences between the three types of twin groups are found for social adjustment at 1, 2, 3, and 4 years ($p > 0.025$ to $p > 0.01$); for handling materials at 1, 3, 4, and 5 years ($p > 0.05$ to $p > 0.001$); for learning at 3 and 5 years ($p > 0.05$); for language performance at 4 and 5 years ($p > 0.01$); and for motor development at 1 year ($p > 0.001$).
4.4. Only for social adjustment and handling materials at the age of 4 ($p > 0.025$) and for language performance at 4 and 5 years ($p > 0.025$ and $p > 0.05$) did DZ = and DZ≠ twins differ significantly. In general, there is a tendency for the various types of twins to show significantly different within-pair differences. As already mentioned, within-pair differences are greater in DZ than in MZ twins

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Subtests Bühler-Hetzer Scale									
SOC		LE		MATER		INT		LANG	
MZ	DZ	MZ	DZ	MZ	DZ	MZ	DZ	MZ	DZ
15.4	28.6	9.7	18.6	25.0	21.2				
$F = 4.13$*		$F = 5.85$*		$F = 0.51$					
31.8	63.1	30.2	30.9	27.8	66.7	31.9	34.9		
$F = 4.81$*		$F = 0.01$		$F = 8.31$**		$F = 0.08$			
23.2	70.9	33.4	25.9	57.3	97.2	49.1	77.6	0.1	0.2
$F = 5.99$*		$F = 0.34$		$F = 0.97$		$F = 1.34$		$F = 1.95$	
74.3	159.6	101.4	122.4	62.9	208.8	137.1	187.2	0.5	1.2
$F = 6.04$*		$F = 0.48$		$F = 6.20$*		$F = 1.57$		$F = 5.13$*	
67.1	125.0	112.9	105.0	137.6	120.0	111.2	112.5	0.7	0.7
$F = 2.16$		$F = 0.07$		$F = 0.12$		$F = 0.00$		$F = 0.01$	
120.0	93.0	101.5	126.0	55.4	117.0	110.8	135.0	0.4	0.7
$F = 0.29$		$F = 0.25$		$F = 3.07$		$F = 0.36$		$F = 0.71$	

(see paragraph 3). Also, there is a trend for DZ≠ twins to show greater within-pair differences than DZ = twins.

The latter trend should possibly be explained on the basis of the effect of genetic sex-linked potentials, but certainly also in terms of an increasing effect of environmental influences acting differentially upon twin-partners of different sex. It is to be stressed that in the literature studied, little mention is made of the latter effect. Again we found no significant differences for sensory development or intelligence (as measured by the BH subtest).

5. There seems to be a correlation between gestational length and general level of psychomotor development up to the age of 1 year ($p > 0.05$ to 0.025) (Table 5). If, however, the developmental

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Table 4. *Means, F-ratio, and levels of significance for within-pair differences of MZ, DZ= and DZ≠ twins*

Age	DQ (BH)			IQ (LIPS)			SENS			MOTOR		
	MZ	DZ=	DZ≠	MZ	DZ=	DZ≠	MZ	DZ=	DZ≠	MZ	DZ=	DZ≠
6m.	4.8	10.0	8.4				3.3	8.7	7.9	11.6	19.7	15.0
$df_1 = 2$												
$df_2 = 76$		$F = 3.21$*						$F = 1.49$			$F = 1.70$	
1y.	10.1	11.5	9.5				29.0	22.5	9.5	16.5	52.8	50.4
$df_1 = 2$												
$df_2 = 66$		$F = 0.16$						$F = 1.73$			$F = 8.50$***	
2y.	4.6	4.0	6.2				4.1	5.6	6.9	42.9	61.9	38.1
$df_1 = 2$												
$df_2 = 48$		$F = 2.32$						$F = 0.14$			$F = 0.37$	
3y.	6.5	8.7	13.9							137.1	192.0	72.0
$df_1 = 2$												
$df_2 = 43$		$F = 8.22$**									$F = 2.35$	
4y.	4.2	4.2	8.1	15.5	8.8	12.7				0.0	30.0	30.0
$df_1 = 2$												
$df_2 = 38$		$F = 7.67$**			$F = 1.76$						$F = 1.7$	
5y.	4.3	3.8	7.4	12.5	8.5	18.0				55.4	0.0	0.0
$df_1 = 2$												
$df_2 = 30$		$F = 3.56$*			$F = 3.62$*						$F = 1.38$	

Notes. See Table 3.

quotient is calculated on the basis of the age the child would have if he had been born at term, these significances disappear.

We also found significant correlations between birth weight (measured in three levels) and DQ up to the age of 1 year ($p > 0.01$ to $p > 0.001$). At later ages the trend is in the same direction, although the relationships is not significant. At the age of 5 years the correlation between birth weight and IQ (LIPS) is also significant ($p > 0.05$) (Table 5). It should be noted that no cases of extremely premature babies or neonates with extremely low birth weight occurred in our sample. This is ascribed — at least partially — to the fact that the mothers were supervised very carefully and most of them were hospitalized during the end of pregnancy.

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Subtests Bühler-Hetzer Scale															
SOC			LE			MATER			INT			LANG		
MZ	DZ=	DZ≠	MZ	DZ=	DZ≠	MZ	DZ=	DZ≠	MZ	DZ=	DZ≠	MZ	DZ=	DZ≠
15.4	30.6	26.6	9.7	19.4	17.4	25.0	24.6	15.8						
	$F = 2.20$			$F = 2.97$			$F = 0.95$							
31.8	59.3	67.1	30.2	33.3	28.4	27.8	74.5	58.4	31.2	45.0	24.2			
	$F = 4.34^{*}$			$F = 0.27$			$F = 8.03^{***}$			$F = 2.79$				
23.2	80.6	58.8	33.4	22.5	30.0	57.3	75.0	124.6	49.1	61.9	96.9	0.1	0.3	0.2
	$F = 5.72^{**}$			$F = 0.48$			$F = 1.92$			$F = 2.63$			$F = 3.02$	
74.3	128.0	207.0	101.4	95.0	162.0	62.9	180.0	252.0	137.1	180.0	198.0	1.6	0.5	1.2
	$F = 9.45^{***}$			$F = 3.74^{*}$			$F = 6.48^{**}$			$F = 1.47$			$F = 2.04$	
67.1	70.0	180.0	112.9	100.0	110.0	137.6	45.0	195.0	111.2	82.5	142.5	0.8	0.4	1.2
	$F = 7.89^{**}$			$F = 0.06$			$F = 6.82^{**}$			$F = 1.46$			$F = 7.20^{**}$	
120.0	98.2	86.7	101.5	76.4	186.7	55.4	98.2	140.0	110.8	106.4	170.0	0.5	0.4	1.1
	$F = 0.16$			$F = 4.16^{*}$			$F = 3.94^{*}$			$F = 2.15$			$F = 6.33^{**}$	

6. Between the ages of 2 and 5 years, twins from higher socioeconomic classes (Table 6) show a higher general level of development, language, and intelligence (LIPS) (levels of significance from 0.025 to 0.001). Before the age of 2 years the findings point in the same direction, but only reach the 0.25 level of significance. The relationship between educational care and general level of development is significant at the 0.05 or 0.001 level from 6 months to 5 years (Table 6). For intelligence (LIPS) and language, too, there is a significant correlation with educational care between the ages of 2 and

* When a sufficient number of cases become available, the relationship between socioeconomic class and psychological stimulation will be investigated in depth.

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Table 5. *Influence of gestational length and birth weight on the development of twins*

Age	Gestational Length (A)					
	DQ (BH)			IQ (LIPS)		
	I	II	III	I	II	III
6m.	88.6	106.9	112.6			
$df_1 = 2$						
$df_2 = 76$		$F = 4.05$*				
1y.	102.6	107.4	112.3			
$df_1 = 2$						
$df_2 = 66$		$F = 3.74$*				
2y.	100.5	94.8	95.3			
$df_1 = 2$						
$df_2 = 48$		$F = 1.39$				
3y.	102.2	101.4	99.6			
$df_1 = 2$						
$df_2 = 43$		$F = 0.30$				
4y.	107.9	102.7	101.0	103.7	93.9	98.9
$df_1 = 2$						
$df_2 = 38$		$F = 2.64$			$F = 2.18$	
5y.	99.7	105.5	102.4	99.0	98.8	100.6
$df_1 = 2$						
$df_2 = 30$		$F = 2.04$			$F = 0.04$	

Notes. See Table 1. (A) Gestational length: I = < 259 days; II = from 259 to 266 days; III = > 266 days. (B) Birth weight: I = < 2,300 g; II = from 2,300 to 2,700 g; III = > 2,700 g.

5 years ($p > 0.025$ to $p > 0.001$) (Table 5B). Thus, educational care seems to be important at the age levels studied.

7. At the ages of 2 and 3, twins of primiparae show a higher general level of development ($p > 0.01$ and 0.001) than the twins of multiparous mothers (Table 6C). This finding is contradictory to expectations based on medical and somatical data. However, it is in agreement with the results of studies conducted by Bayley and with our investigations (Decoster 1974) of children of mothers in whom labor had been artificially induced with intravenous prostaglandin F2α. A multiparous mother who has other children to care for has fewer opportunities for stimulating actively when her youngster

Birth Weight (B)					
DQ (BH)			IQ (LIPS)		
I	II	III	I	II	III
82.9	108.6	110.4			
	$F = 5.81$**				
99.7	106.7	113.6			
	$F = 9.14$***				
96.6	100.4	93.9			
	$F = 1.88$				
97.5	102.2	103.5			
	$F = 1.79$				
98.9	106.3	104.9	92.9	100.8	100.4
	$F = 3.04$			$F = 1.73$	
99.6	105.9	101.0	91.7	105.1	99.9
	$F = 2.65$			$F = 4.15$*	

is 2 to 3 years old. This does not necessarily mean, however, that any lasting damage is done to the child. This effect is most important at the ages of 2 and 3. Before 2 years, the child's development depends more strongly on constitution and maturation. After 3 years of age, there is an additional effect on development of the nursery school. In any case, before the age of 2 and after the age of 3, the differences between twins of primiparae and multiparae are not significant.

8. No significant differences were found between first — and second — born twin partners, a conclusion which is at variance with most of the reports in the literature. A tentative explanation of this divergence may be that very few of the twins sampled had suffered from birth complications. Moreover,

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Table 6. *Influence of environmental factors on the development of twins*

Age	Socioeconomic Class (A)											
	DQ (BH)			IQ (LIPS)			LANG			DQ (BH)		
	I	II	III	I	II	III	I	II	III	I	II	III
6m.		207.2	198.4							94.6	92.7	114.0
$df_1 = 2$ $df_2 = 76$		$F = 0.32$ (D)									$F = 3.50$*	
1y.		208.0	219.0							105.9	101.8	114.8
$df_1 = 2$ $df_2 = 66$		$F = 1.75$ (D)									$F = 7.78$***	
2y.	93.5	97.3	102.8				0.6	1.0	1.2	80.9	96.3	103.9
$df_1 = 2$ $df_2 = 48$		$F = 3.94$*						$F = 5.40$**			$F = 34.38$***	
3y.	97.4	101.1	107.2				2.6	3.2	3.8	89.1	97.1	110.3
$df_1 = 2$ $df_2 = 43$		$F = 4.00$*						$F = 6.59$**			$F = 24.78$***	
4y.	101.5	100.6	112.4	94.7	95.1	109.9	4.4	4.6	5.9	96.2	99.2	111.7
$df_1 = 2$ $df_2 = 38$		$F = 9.47$***			$F = 7.39$**			$F = 9.55$***			$F = 16.99$***	
5y.	103.4	96.7	109.1	94.7	94.9	111.9	6.5	6.7	7.4	96.7	102.5	104.6
$df_1 = 2$ $df_2 = 30$		$F = 11.76$***			$F = 10.26$***			$F = 6.24$**			$F = 3.37$*	

Notes. See Table 1. (A) I = lower class; II = middle class; and III = higher class. (B) I = low educational care; II = moderate or normal educational care; and III = high educational care. (C) I = no other children in the family; II = one brother or sister; and III = two or more brothers or sisters. (D) At the ages of 6 months and 1 year, socioeconomic classes I and II are not differentiated. As a consequence, degrees of freedom become $df_1 = 1$ and $df_2 = 77$ at 6 months, and $df_1 = 1$ and $df_2 = 67$ at 1 year of age.

if as a rule the first-born twin is more endangered by mechanical stress during labor and delivery, it is less affected by biochemical noxae, mainly hypoxia. The latter conclusion is based on the fact that our investigation on children who had suffered intrauterine hypoxia did not show any handicap with respect to psychomotor development during the first year. Only after the second year does a not precisely localizable vulnerability gradually show up (mainly with respect to personality development).

9. The occurrence of mirror-imaging does not seem to be influenced by early cleavage of the ovum. As yet, we have not been able to determine whether late cleavage of the ovum results in a higher incidence of this phenomenon. Only when this is known will we be able to compare our results ade-

Educational Care (B)									Parity (C)					
IQ (LIPS)			LANG			DQ (BH)			IQ (LIPS)			LANG		
I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
						105.9	105.3	93.9						
							$F = 1.01$							
						109.5	104.2	107.3						
							$F = 1.10$							
			0.4	0.7	1.3	104.3	93.2	90.9				1.2	0.8	0.6
				$F = 19.80$***			$F = 10.83$***						$F = 9.20$***	
			1.8	2.9	3.9	106.8	99.5	95.5				3.5	3.2	2.5
				$F = 23.69$***			$F = 5.92$***						$F = 4.59$*	
87.2	93.7	108.4	3.9	4.6	5.6	105.7	104.8	100.4	101.6	101.1	91.7	5.0	5.1	4.3
	$F = 12.45$***			$F = 9.06$***			$F = 1.57$			$F = 2.86$			$F = 2.20$	
88.8	97.2	105.6	6.5	6.5	7.2	101.7	103.8	101.7	101.1	101.4	95.5	7.0	6.5	6.7
	$F = 5.35$*			$F = 7.41$**			$F = 0.18$			$F = 0.92$			$F = 0.36$	

quately with those of authors like Newman (1940), who concluded that the incidence of mirror-imaging is higher for late (4 to 10 days) than for early cleavage (1 to 4 days).

10. According to the literature, domination of one partner is more frequent among MZ twins (von Bracken 1936, Leonard 1959, Koch 1966). More rivalry was found between DZ twin partners (Leonard 1959, Zazzo 1960, Koch 1966). In our studies, however, we did not find significant differences of this kind. On the other hand, we found coincidence of rivalry and domination in twin partners; this relationships was significant between the ages of 2 and 5 years ($p > 0.05$).

As already mentioned, these are of necessity only preliminary conclusions and will have to be supplemented both by further follow-up of the present group and inclusion of larger numbers of propositi.

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APPENDIX

We plan to follow-up the twins through primary school. At that level, the test battery used both for twins and singletons will include:

1. The *Nijmeegse Schoolbekwaamheidstest* (Mönks et al. 1971) to evaluate school readiness.
2. The *Analytische Intelligentietest* (Knops 1967), an adaptation of *Thurstone's SRA Primary Mental Abilities* to evaluate intelligence.
3. Sociometric questions.
4. Personality will be evaluated by:
   - — the *Bender Gestalt Test* (scoring system: Koppitz 1971);
   - — the *Family Relations Test* (Bene and Anthony);
   - — the *Draw a Person test* (scoring system: Koppitz 1971);
   - — the *Eearly School Personality Questionnaire* (Coan and Cattell 1966);
   - — the *Where Are You Game* for the measurement of the self-concept (Engel and Raine 1963);
   - — the *General Manifest Anxiety Scale* (Sarason 1960);
   - — an interview (*Questionnaire measuring the siblings' or twin relations*) and
   - — the *Child Behavior Rating Scale* (Cassel 1962).

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Prof. Willy De Coster, Department of Developmental Psychology, Ghent University, 4 Aan de Becht, 9000 Ghent, Belgium.