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# The Southern California Twin Register at the University of Southern California

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Laura A. Baker, Mafalda Barton and Adrian Raine  
*Department of Psychology, University of Southern California, USA*

The Southern California Twin Register is the result of an effort to recruit twins of all ages in the city of Los Angeles and surrounding areas. The register currently includes an ethnically diverse sample of more than 2600 twin pairs. The most recently recruited pairs have been drawn primarily from computerized records of enrollments in local public school districts, and are comparable in sex and ethnic distributions to the general public school population. An ongoing twin study of social and moral development in children, based on 600 pairs of 9-year-old twins from this register, is also described briefly in this paper.

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There are enormous opportunities for recruiting twins in large metropolitan areas such as those in southern California. In Los Angeles County alone, the general population exceeded 9.5 million in the year 2000 (US Census Bureau, 2000). Based on multiple birth rates of at least 1%, we estimate there to be over 100,000 twin pairs living within an hour's drive from downtown Los Angeles. Given the racial and cultural diversity in this area, there is a unique opportunity to sample twins from a wide range of backgrounds, unlike most other registers. We describe here one of several twin registers which currently exist in the State of California.

This is an ongoing register of twins of all ages, and is maintained by research investigators at the Southern California Twin Project, which is housed in the Psychology Department at the University of Southern California (USC). Various ethnic groups are represented in the register, comparable to those found in the southern California urban community. Laura Baker established the register in 1984, for purposes of conducting research on genetic and environmental influences in human behavior. The register includes male and female, monozygotic (MZ) and dizygotic (DZ) twin pairs of all ages — both same-sex and opposite-sex DZ pairs are represented. We describe here the various recruitment efforts employed to locate twins over the years, and the current sample size according to age, sex, and ethnicity.

From 1984–1999, twin pairs were recruited through the following sources, listed in order of largest to least ascertainment: newspaper and radio advertisements, twin clubs, local schools, local hospitals, and referrals. Recruitment through school districts primarily involved our staff contacting individual schools and sending letters of invitation to parents of multiples via their children (the “backpack express”). Funding for the twin register was

minimal during this time, stemming primarily from small university grants to the investigators.

Beginning in January 2000, the opportunity to expand the register and refine our recruitment methods was made possible through NIMH funding (#MH 58354; Laura Baker — PI; Adrian Raine, co-PI). During the past three years (2000–2002), our emphasis has been on recruiting twins primarily through public schools in Los Angeles and surrounding communities. Several school districts have aided our recruitment of twins, including the Los Angeles Unified School District, with enrollments exceeding 700,000 pupils in grades K–12 during the 2001–2002 academic year. Our recent efforts have been focused on locating elementary school-age twins to participate in an ongoing study of childhood behavior problems. Thus, the twin register expansion in the past three years has been primarily in children attending public elementary schools.

Combining earlier and recent twin pairs who have joined the Southern California Twin Register, we currently have over 2600 twin pairs in our database. A more detailed description of our recruitment procedures in the school districts is described next, followed by an overview of the ongoing, NIMH supported twin study of childhood behavior problems.

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## School District Recruitment of Twins

Using sorting and matching procedures on computerized databases of pupils, school districts are able to identify possible twin pairs with great accuracy. Pupils are sorted by last name, birth date, and home address. Any two individuals living in the same home and born on the same day are almost certainly twins or other multiple births. Most school districts are reluctant to provide names and contact information directly to anyone outside of district personnel, for reasons of privacy and confidentiality. Those families identified as having twins using this sorting method, therefore, are sent letters inviting them to contact our staff at USC. Any family receiving our letter of invitation are asked to return a postage-paid form indicating (a) whether they in fact do have twins; and if so (b) whether they wish to be included in the Southern California Twin Register. Letters

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*Address for correspondence: Laura Baker, Department of Psychology, University of Southern California, Los Angeles CA 90089-1061 USA. Email: lbaker@usc.edu*

of invitation and information forms are sent in English, Spanish, Mandarin Chinese, Vietnamese, and Armenian, according to the preferred language by individual families for school district mailings.

To date, 14 different school districts in Southern California have assisted in our recruitment efforts, including the largest school district (LAUSD; see Table 1). Over 6800 letters have been sent to families identified as having a multiple birth in their family. Of these, only 22 (0.3%) have returned the requested form indicating they do not have twins in their family — thus, the sorting and matching procedures appear to work remarkably well. A small number of letters ( $n = 270$ ; 4%) were returned to us due to incorrect mailing addresses. Out of the remaining families, positive response rates vary considerably across districts (from 14–45%), with a median response rate of 26.6%. For the largest school district (LAUSD), two mailings have resulted in a combined response rate between 25–30%. We are in the midst of sending follow-up letters of invitation to non-responders, in order to increase register participation rates.

### Sample Characteristics

Distributions of birth year and sex for the twin pairs in the Southern California Twin Register are provided in Tables 2–3, separately for the early and recently recruited samples. It should be noted from Table 1 that the early sample consists primarily (83.4%) of adults — age 18 and older (i.e., born prior to 1983). The more recent sample, having been recruited almost entirely from school district mailings, is primarily (93.5%) comprised of children (i.e., born since 1983). As may be calculated from Table 3, females are slightly over-represented (58.3%), as are female-female

twin pairs (49.3%), while opposite sex pairs are under-represented (18.0%) in the early sample. These patterns are characteristic of adult volunteer samples, in which females and MZ pairs tend to respond and participate in studies more often than expected from population rates (see Lykken et al., 1987). Although true zygosity is not known for many of the pairs in the early sample, it is likely that the preponderance of female-female pairs is due to an oversampling of MZ pairs. In contrast, the sex distributions are closer to those expected in the population (50% female individuals; one third opposite sex pairs) in the recent child sample (53% females; 27.3% opposite-sex pairs). The reduction in sampling bias for sex and twin type may be due to both the recruitment procedures (letters of invitation to all twins enrolled in a school district) and the fact that the actual respondents are the parents and not the twins themselves.

A unique aspect of the Southern California Twin Register is its ethnic diversity, which stems from the regional variations in Los Angeles and the surrounding urban communities. Table 4 shows the ethnic breakdown of twin pairs in the recent sample. (This information is not available for a large majority of the earlier sample.) As shown, Hispanics comprise the largest single group in the sample (48.2%), followed by Whites (21.3%), then Blacks (17.9%). There is also a sizeable group of twin pairs whose parents identified themselves of mixed or other races (6.9%), the largest of which include some Hispanic descent. Aside from the mixed/other grouping, these percentages are in the same rank order as the ethnic distributions in the general school district populations (see Table 4). Adjusting for racial differences in twinning rates, however (see PHS, 1997), it appears that Whites are over represented in the

**Table 1**  
Participation and Response Rates by School District

School District	# Sent	# Pos. Resp.	# Neg. Resp.	# "No. Twin" Resp.	# Wrong Address	Response Rate	Refusal Rate	Targeted Age Range
Alhambra City 1st Mailing (1999)	150	21	6	7		14.69%	4.20%	K-12
Alhambra City 2nd Mailing (2001)	25	5			1	20.83%		7–9 y.old
Anaheim City	76	11	4			14.47%	5.26%	7–9 y.old
Arcadia Unified	36	16	4			44.44%	11.11%	5–10 y.old
Buena Park Elementary	54	11	1		1	20.75%	1.88%	K–8
Burbank Unified	42	12				28.57%		6–9 y.old
Garvey	60	20	7			33.33%	11.66%	6–9 y.old
Lennox	25	1				4.00%		6–9 y.old
Los Angeles Unified 1st Mailing	4379	1030	102	7	194	24.65%	2.44%	K–12
Los Angeles Unified 2nd Mailing	1546	229	21	1	69	15.51%	1.42%	7–9 y.old
Montebello Unified	159	29	5	5	3	19.21%	3.31%	7–9 y.old
Pasadena Unified	41	17		2	2	45.95%		7–9 y.old
Rowland Unified	82	24				29.27%		6–10 y.old
Santa Monica-Malibu Unified	36	13	5			36.11%	13.89%	6–9 y.old
Torrance Unified	42	15	3			35.71%	7.14%	6–9 y.old
Whittier City	52	15	1			28.85%	1.92%	6–9 y.old
	6805	1469	159	22	270	Median = 26.61%		

**Table 2**  
Twin Pairs by Year of Birth (Early and Recent Samples)

Birth Year	Early Sample		Recent Sample		Total
	<i>N</i>	%	<i>N</i>	%	
< 1930	44	4.0			44
1931–1935	12	1.1			12
1936–1940	13	1.2			13
1941–1945	26	2.4			26
1946–1950	48	4.4			48
1951–1955	63	5.8			63
1956–1960	57	5.2	1	<.1%	58
1961–1965	64	5.9			64
1966–1970	77	7.1			77
1971–1975	154	14.1			154
1976–1980	183	16.8			183
1981–1985	236	21.7	244	16.1	480
1986–1990	68	6.2	471	31.2	539
1991–1995	2	.2	739	48.9	741
1996–2000			21	1.4	21
Unknown	42	3.9	36	2.4	78
<b>Total</b>	<b>1089</b>		<b>1512</b>		<b>2601</b>

**Table 3**  
Twin Pairs by Sex (Early and Recent Samples)

Sex of twins	Early Sample (%)	Recent Sample (%)
Male-Male	355 (32.7%)	485 (33.4%)
Female-Female	534 (49.3%)	572 (39.3%)
Male-Female	195 (18.0%)	397 (27.3%)
Unknown	5	58

Note: Percentages (in parentheses) are based on pairs in which sex of both twins is known.

**Table 4**  
Breakdown of Recent Sample by Race

Race of Twins	<i>N</i> pairs (%)	School District %	Los Angeles County %
White, Non-Hispanic	301 (21.3%)	11.5%	31.1%
Black	251 (17.7%)	11.4%	9.8%
Hispanic	682 (48.2%)	68.7%	44.6%
Asian	69 (4.9%)	5.8%	11.9%
Pacific Islander	6 (0.4%)	.4%	.3%
Mixed or Other	106 (7.5%)	2.3%	4.9%
Unknown	97		

twin register (compared to 11% in the school district population), while Hispanics are correspondingly underrepresented (compared to 68% in the school district population). Although a greater percentage of Blacks appears in the recent register sample compared to school district figures, this may be largely explained by the higher twinning rate in this group. Language barriers may affect the lower response rate

in Hispanics, although comparable letters of invitation and brochures are sent in both English and Spanish to families identified as having Spanish as their preferred language for school district mailings. Response rates in both Blacks and Asians are comparable to the adjusted school district percentages (15% and 4%, respectively). Thus, language barriers have not appeared to affect Asian response rates as severely as in Hispanics.

Compared to the wider population in Los Angeles County (from which most of the recent sample reside), there do appear to be some important differences. Again, the over sampling of Blacks may be due to their higher twinning rate compared to the other groups. The underrepresentation of Whites in the twin register, however, (compared to Los Angeles in general) may be largely due to their lower attendance of public schools than other ethnic groups. One of our future aims in the twin register is to make additional recruitment efforts in private schools, in order to increase the relative number of White participants to be comparable to the greater Los Angeles area.

**Ongoing Study of Social and Moral Development**

We are currently engaged in a large twin study of childhood behavior and learning problems, including antisocial behavior and attention deficit disorder. Our primary aim is to understand how genes and environment may influence antisocial behavior and its relationships with various biological and social risk factors. The study is funded primarily through a grant from NIMH (#MH58354). Through a small grant from the International Dyslexia Society, we are concurrently studying reading disability and its relationship to conduct problems in these same twins.

These studies involve a 6–8 hour laboratory assessment of 9-year-old twin pairs and their primary caregivers. The testing session includes cognitive and neuropsychological testing, as well as structured clinical and behavioral interviews of both the twins and the caregiver. Diagnoses are made for conduct disorder, attention deficit disorder (ADHD), oppositional defiant disorder, and general anxiety and depression in the twins. Social risk factors for aggression and delinquency are also evaluated through the behavioral interviews — these include peer characteristics, family relationships, socioeconomic status, and neighborhood characteristics. Biological risk factors are also measured, including prenatal factors, birth complications, and family history of a wide range of physical and mental disorders. An extensive 2.5 hour psychophysiological assessment is also made of each twin, including electroencephalogram (EEG) and event related potential (ERP) measures, as well as cardiac and electrodermal responding during a wide variety of cognitive and emotion-related tasks. DNA samples are also obtained for zygosity purposes, as well as for tests of specific genetic associations for reading disability and ADHD.

To date, over 300 families have been tested out of the target sample of 600 twin pairs. The first wave of data collection is expected to be complete by December 2003. Additional follow-up assessments are planned through young adulthood, contingent upon funding. Collaborations with other researchers interested in twin populations are

welcome, provided they do not impinge on our current and proposed projects that involve this register.

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