organelles, in a positive perikaryon were labeled. A few granules were consistently weakly positive or negative. The diameter of the somatostatin-containing granules was 80 to 110 nm. Even if the tissue was fixed in aldehyde only, it was possible to identify the rough endoplasmic reticulum, the mitochondria, and the plasma membrane delineating the somatostatin-containing neurons. However, fixation with aldehyde did not permit an extensive ultrastructural study of the positive secretory neurons. Axons containing positive secretory granules were routinely found throughout the sections. Other secretory neurons containing negative granules of smaller size (40 to 70 nm) were observed in the same area. On the basis of the distribution of the somatostatin cells as well as the diameter of their granules, it is relatively easy to identify this cell type in the tissue fixed in osmium. This cell has all the characteristics of a secretory neuron (Fig. 2b). Its rough endoplasmic reticulum and Golgi apparatus are well developed and the secretory granules as well as the lysosomes are relatively abundant.

The distribution of somatostatin-containing cell bodies observed in this study is in agreement with previous immunohistochemical studies with the light microscope (*4*). The absence of reaction in a small percentage of granules in the somatostatin-producing neurons remains to be explained. Since the diameter of the somatostatin-containing granules is the same in the perikarya and nerve endings (*3*), we suggest that somatostatin is stored in cytoplasmic granules before being transported into the vicinity of the fenestrated capillaries of the pituitary portal plexus. Thus, the somatostatin system appears to be very similar to the magnocellular system involved in the production of vasopressin and oxytocin (*7*).

GEORGES PELLETIER
DONALD DUBÉ
ROMANO PUVIANI

Medical Research Council Group in Molecular Endocrinology, CHUL, Quebec G1V 4G2, Canada

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Birth Order and Intellectual Development: The Confluence Model in the Light of Cross-Cultural Evidence

Abstract. *For Israeli eighth-grade students of Asian-African origin, achievement decreases as a function of birth order in small families and increases as a function of birth order in large families. This finding cannot be accounted for by differences in developmental rate or size of birth intervals. It can be accounted for by considering the effect of external influences, such as schooling, on intellectual development.*

Using test performance on Raven Progressive Matrices of Dutch army recruits presented by Belmont and Marolla (*1*), Zajonc and Markus (*2*) have formulated a model that relates intellectual development to birth order and family size. The model defines intellectual environment in the home as the average of the absolute intellectual levels (that is, mental age rather than intelligence quotient) of all the inhabitants. The intellectual development of each child is affected by the intellectual environment, and his or her increase in level, in turn, raises the average level of the home. According to the model, family size has an effect because in larger families a greater proportion of the inhabitants are at lower intellectual levels. The effects of birth order result from the growth of later-born children in an environment that reflects the relatively low intellectual levels of their older siblings. However, the decreasing performance for later-born children in large families can be reversed as older children mature and provide them with a richer environment.

We now present achievement test data of eighth-grade Israeli students as a function of birth order and family size and

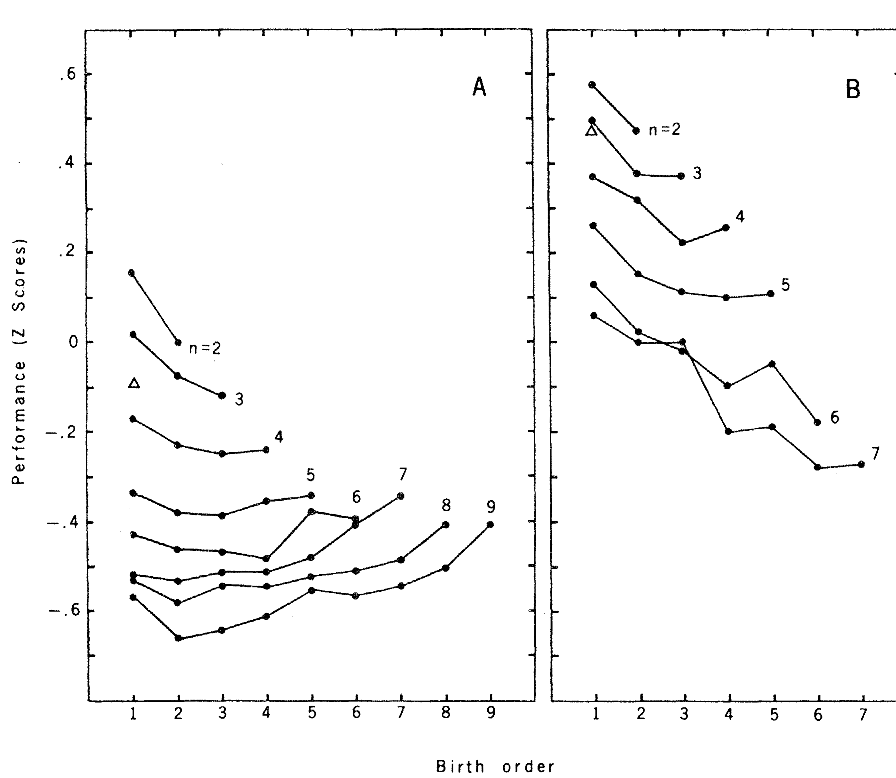

Fig. 1. Mathematics test performance (in z scores) at age 14 as a function of birth order and family size (number of children, n). For $\triangle$, $n = 1$. (A) Israeli students of Asian-African origin, born between 1951 and 1956 ($N = 109,304$). (B) Israeli students of European-American origin, born between 1951 and 1956 ($N = 82,689$). (Because of very low frequencies of large families in this sample, the results for family sizes above 6 are grouped.)

discuss the implications for the confluence model. The data are based on a standard achievement test given to all eighth-grade elementary school students in Israel (*3*). We present the results on the arithmetic computation and mathematical problem-solving subtests for 191,993 children tested in the years 1966 to 1970. In most cases only one child per family is represented in the sample.

The results are presented separately for students whose fathers immigrated from Europe, America, South Africa, and Australia (N = 82,689) and for students whose fathers immigrated from Middle Eastern and North African countries (N = 109,302). The first group has a Western cultural pattern, while the second group has a Middle Eastern or "Oriental" cultural pattern. The performance scores are standardized to a distribution with $\overline{X} = 0$ and standard deviation (S.D.) = 1 for the population as a whole. The averages are plotted as a function of family size and birth order (Fig. 1). In the Western sample, later-born children generally perform more poorly, but at some point there is a tendency for the curves to turn up. In contrast, the Oriental sample exhibits a strong interaction of family size and birth order; in small families, performance decreases for later-born children, but in large families, performance increases for later-born children. The similarity of each of these patterns to some of those presented by Zajonc (*4*) indicates that the confluence model could be used to explain achievement-test results as well as intelligence-test results (*5*).

According to the confluence model, decreasing performance as a function of birth order is arrested and reversed when older children in the family have matured enough so that the later-born children enjoy a relatively rich intellectual environment. Further, the birth-order rank at which the reversal occurs depends on two factors, the rate of intellectual development and the size of birth intervals. Greater developmental rates and larger intervals lead to a reversal at earlier birth-order ranks. Zajonc explains highly disparate patterns of intellectual performance as a function of family size and birth order on the basis of differences in birth intervals only. In French and Scottish samples, improved performances as a function of birth order have been explained by relatively large birth intervals, and in Dutch and U.S. samples, decreasing performances as a function of birth order have been explained by relatively small birth intervals (*4*).

In order for this explanation to hold true for the results shown in Fig. 1, two

Table 1. Mothers with some formal education as a function of family size (number of children) and subpopulation.

Family size	Mothers (%)	
	Oriental	Western
1	64	98
2	81	99
3	76	98
4	63	95
5	50	91
6	40	86
7	35	83
8	32	78
9	28	77

conditions must be met. (i) Within the Israeli-Oriental sample, birth intervals must be greater in large families; and (ii) in large families, birth intervals must be greater in the Oriental than in the Western sample. Although we have no direct data, it is unlikely that either of these two conditions is met. In fact, change in birth rate, the indirect measure of birth interval used by Zajonc, was negative in both Israeli samples (*6*). In addition, it is unlikely that Oriental children develop more quickly than Western children and that Oriental children in large families develop more quickly than those in small families.

The inability of birth interval or developmental rate differences to explain the results led us to consider parents' intellectual levels. In large families of very high intellectual level, it is not likely that older children will have developed to the point at which they contribute more than the parents to the intellectual environment of the home. However, in large families with parents of very low intellectual level, and where children are learning outside the home, it is likely that older siblings will contribute more than the parents at a relatively early age.

We would expect two different patterns of intellectual environment as a function of birth order in these two cases. The first case would lead to decreasing intellectual environments as a function of birth order with the possibility of an upswing for the latest-born children. However, the richest environments would be enjoyed by the first two or three children. The second case would lead to a slight decrease in intellectual environments at the early birth ranks, and the upswing would appear sooner than in the first case. Also, the richest environments would be enjoyed by last-born children.

We use an example of Zajonc and Markus to illustrate that by varying the intellectual levels of parents relative to those of their older children, the two patterns can be predicted by the confluence model. In their table 1 of (*2*), Zajonc and Markus calculate the intellectual level in the home at birth as a function of birth order. Using the same assumptions and procedure but with varying values of parents' intellectual levels, we obtained the pattern in Fig. 2. As the parents' intellectual levels decrease there are two important changes in the curve of intellectual environment at birth as a function of birth order. (i) The environment starts to increase sooner and (ii) the intellectual environments of later-born children surpass those of early-born children. These are the two features evident in the Israeli-Oriental achievement curves for different family sizes. Therefore, if the parents' intellectual levels in large Israeli-Oriental families are generally below those of older siblings, and if this is not the case in small Israeli-Oriental families or in Israeli-Western families, the pattern of results can be predicted by the confluence model.

Large and small Israeli-Oriental fami-

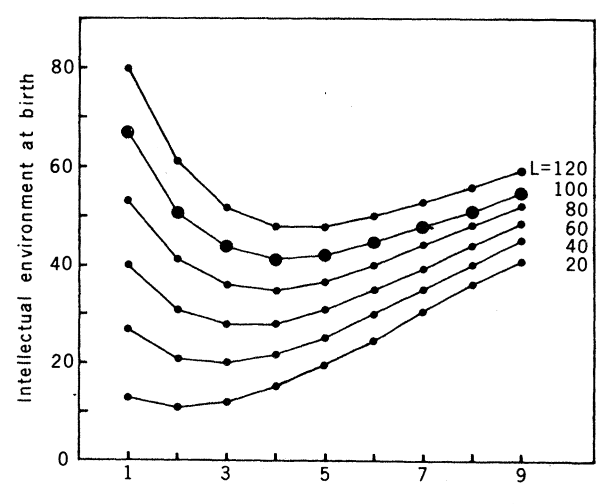

Fig. 2. Intellectual environment at birth as a function of birth order for different values of parents' intellectual level (L) under the assumptions of a 2-year gap, a time constant of 0.1, and that children develop to an intellectual level of 100. Therefore, the absolute intellectual level of a child is $100(1 - e^{-.01t^2})$ where t is age in years. The curve marked by large circles indicates that the parents' intellectual level is equal to those of their children at maturity.

lies differ in the percentage of mothers with some formal education (Table 1). More important, since school attendance was compulsory until the eighth grade, older children in the large families may soon have surpassed their parents in their ability to educate and help the younger children in the family. This hypothesis is verified by data from questionnaires obtained from a representative sample of 4321 Israeli sixth-grade children in 1973. With the number of older children held constant and with decreasing formal education for the parents, children are more likely to report that an older sibling rather than a parent helps with homework and takes an interest in school activities. For example, when the child has two older siblings and neither parent has formal schooling, about 88 percent report that an older sibling rather than a parent helps with homework. The corresponding figure when at least one parent studied beyond high school is 31 percent.

A process by which children overtake their parents in providing intellectual stimulation for younger siblings could be described by the confluence model, either in its original or revised version (*7*). However, accurate simulation by the model of our data would require that the rate parameters be greatest in large Oriental families. An alternative approach would view intellectual development as a function of the external as well as the home environment. This approach does not contradict the model but adds a component of intellectual development that is independent of the intellectual environment of the home. This component should be particularly evident in rapidly developing cultural groups or societies in which educational institutions provide greater intellectual stimulation than parents do.

DANIEL J. DAVIS*
Department of Psychology, Temple University, Philadelphia, Pennsylvania 19122
SOREL CAHAN, JOSEPH BASHI
School of Education, Hebrew University, Jerusalem, Israel

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Cannabinoids Inhibit Testosterone Secretion by Mouse Testes in vitro

Abstract. *Addition of delta-9-tetrahydrocannabinol or cannabinol to an incubation medium containing decapsulated mouse testes caused a significant reduction in the accumulation of testosterone in the medium. This result suggests that the reported effects of cannabis on male sexual and reproductive function may result from direct inhibition of testicular steroidogenesis by both psychoactive and nonpsychoactive constituents of marihuana.*

Marihuana and its psychoactive constituent, delta-9-tetrahydrocannabinol (THC), have been implicated in the alteration of testicular function in several species including man. Administered through various routes, either marihuana or THC can reduce the concentration of testosterone (T) in peripheral plasma in both rat and man (*1, 2*), suppress spermatogenesis and produce changes in sperm-head proteins (*3, 4*), and reduce the weight of the testes and the accessory reproductive organs (*3–5*). A reduction in certain androgen-dependent behavioral responses, such as intra- and interspecies aggression (*6*) and copulatory behavior in male rats and mice (*7*), has also been observed. In men, reduced sexual potency and gynecomastia (*1, 2, 8*) have been reported in heavy marihuana users. However, changes in aggressive and sexual behavior induced by cannabinoids may be related to the action of these compounds on higher brain centers rather than to changes in the function of the hypothalamic-pituitary-testicular system.

Cannabis-related decreases in peripheral luteinizing hormone (LH) and prolactin levels (*1, 2, 9*) suggest that alteration in testicular function may be secondary to suppression of the pituitary. Increased adrenal weight (*5*) and corticosterone production (*10*) with cannabis treatment suggest another possible mechanism for the alteration in testicular function.

In contrast, the demonstration of an inhibitory effect of THC, cannabinol (CBN), and other cannabinoids on the synthesis of protein and nucleic acid in incubated testicular slices (*11*) suggests that THC may act directly on the testis. We therefore studied whether these cannabinoids are capable of directly affecting the testicular biosynthesis of T in vitro. We examined the effects of THC and CBN (which is believed not to be psychoactive) using decapsulated mouse testes in an in vitro incubation system.

Adult (2 to 3 months of age) or immature (34 to 37 days) closed-colony but not inbred laboratory mice were killed by cervical dislocation; the testes were immediately removed, decapsulated, and incubated in Krebs-Ringer bicarbonate buffer, glucose (1 mg/ml), and 12.5×10^{-3} international unit of human chorionic gonadotropin (Follutein, Squibb) per milliliter (*12*). The THC or CBN, at the various doses, was introduced into the incubation medium in a 20-μl volume of ethanol. The same amount of ethanol was added to the control flasks. The concentration of T in the medium after 4 hours of incubation was determined by radioimmunoassay (*13*) after suitable dilution of the aliquot (*14*). As a control, mouse testes were incubated either with ethanol (at doses of 10, 20, or 50 μl/ml) or without ethanol. At these doses, ethanol did not affect T release. The differences between the mean T concentration in alcohol-containing and in control incubations were no greater than 9 percent and were not significant.

The effect of THC on testes obtained from adult mice is shown in Table 1. The

Table 1. Effects of treatment with Δ^9-tetrahydrocannabinol (THC) in vitro on the production of testosterone (T) by the decapsulated testes of adult (2- to 3-month-old) and immature (34- to 37-day-old) mice. The results represent mean (± S.E.) concentration of T in the incubation medium at the end of a 4-hour incubation. The size of each treatment group is shown in parentheses. Abbreviation: N.S., not significant.

Concentration of THC (μg/ml)	Age of mice	Concentration of T (ng/ml)		Inhibition (%)	P
		Controls	Treated		
0.25	Adult	517 ± 58 (8)*	386 ± 27 (8)	25	< .05
2.5	Adult	517 ± 58 (8)*	426 ± 37 (8)	18	N.S.
12.5	Adult	225 ± 24 (11)	159 ± 10 (11)	29	< .02
25	Adult	517 ± 58 (8)*	71 ± 16 (8)	86	< .001
25	Immature	253 ± 33 (12)	118 ± 16 (12)	53	< .001

*Listing identical control values more than once represents comparison of several treatment groups to one control group, all run in a single incubation.