Teaching the Unborn: Precept and Practice

Author: Logan, Brent

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Full Text: Headnote ABSTRACT: Various prenatal stimulation approaches over recent years have resulted in thousands of children with exceptional abilities that do not prove problematic-unlike enhancement lacking an in utero component. Nonetheless, at the inception of every major historical shift transitional measures are idiosyncratic, unsystematically deriving impetus from early success while not yet identifying a common theme in order to promote consistent achievement. This challenge is met through synthesis leading toward comprehensive application. Like a struck tuning fork creates specific visual patterns in certain media (quite different from its audible effect), so heartbeat affects neurogenesis with such seminal information-the binary organizer of higher being-that a vertebrate's entire cognitive and behavioral life is epigenetically structured from this most elementary yet wholly overwhelming event. Relative to initial production, what few brain cells reach postnatality owe their survival to an in utero growth factor exclusively dependent upon cardiac rhythm-gravidic as well as indigenous-beginning preconsciously. By providing a sonoral curriculum of simple but increasingly complex departures from the heartbeat progenitor, over durations sufficient to imprint, neuronal development should be significantly benefitted through greater cell count and/or function, hence improving ontogenetic potential- including empathetic elements. Criteria for such critical process are'presented, along with projected implementation: technical means, clinical modality, and evaluative methodology. THE LUB-DUP LOGOS What is the key to that code which will imprint best, thereby maximizing brain cell number and performance past the normative point just before an infant's birth when massive neuronal depletion occurs? It should come as no unwarranted surprise or unreasonable assumption that the answer must be rhythmic, intermittent, and vibratory, since our cardiac constant is a prime clue. The heart is vertebrate life's one invariably vital factor; no other organ or combination of physiological activity remotely approaches candidacy for an everpresent source of prenatal neurological stimulation-preconscious and conscious. Verny aptly draws attention to the psychodynamics cardiac pulsation establishes in the unborn: Without question, it is an essential part of his life-support system. The child does not know that, of course; he only knows that the reassuring rhythm of its beat is one of the major constellations in his universe. He falls asleep to it, wakes to it, moves to it, rests to it. Because the human mind, even the mind in utero, is a symbol-making entity, the fetus gradually attaches a metaphorical meaning to it. Its steady thump-thump comes to symbolize tranquillity, security, and love to him. In its presence, he usually flourishes.1 Is it but happenstance that the neural tube-our future mind-forms2 coincidentally with cardiac activity's inception? Though later required to provide capillary blood supply to the central nervous system, this tiniest pump serves an earlier if not equally important purpose: what its variable pulses introduce is an omnipresent sense of cyclicalitytemporal and, in preparation for visual data, spatial repetition. Those patterning principles embedded in original being are authors of all subsequent coordinates; every cosmic ingredient becomes calculated by this primary value system, whether speech, song, fluctuations of nature, physical location, even the orders and disorders-deliberate or otherwise-to our minds. Of course, at this most discriminating because utterly simplified stage, neurogenetic taste must run to those stimuli only slightly removed from what has been continuously present. For if "the migrating nerve cell is dependent on its environment and upon clues from neighboring cells in order to reach its proper ultimate destination,"3 of what influence is that constantly repeated message which both constitutes tremors to the totality of environment and unmistakably teaches, instructing sensate neurons in some crude but distinct, native curriculum . . . conveying a range of interacting grammatical rules: similarity, opposition, intensity, temporality? Apart from its special place

in romantic literature, why does the heart serve as chosen locus for holding infants,4 neonatal stimulus promoting greatest weight gain,5 supreme pacifier,6 sole reassuring metronome by which children fall quickly asleep,7-8 and that sonoral magnet attracting newborn chicks?9 Is coincidence responsible for baby's first words-built by halves10-the bisyllabic "mama" and "dada" common to all cultures? Only days after a normal gravida's menstrual period fails to meet schedule, the three-week embryo quivers from its cardiac muscle cells having automatically begun contracting; when stuttering movements give way to regularity, the organism organizes like never before, and two weeks later its burgeoning heart approaches embryonic head size, each pulsation shuddering throughout the entire body.11 But to what end? Those who have seen early vertebrate embryos cannot help being struck by the power of this early source of rhythmic stimulation, arising from the developing organism itself. The mode of this very early spontaneous rhythmic behavior and the effects of the stimulation it provides may go well beyond its obvious function as a pump, but are at present wholly unknown.12 . . . there remains a major mystery in prenatal life-the question of why sensory and motor functions develop and exhibit activity, weeks and even months before they have any clear usefulness to the baby. We find it hard to accept that there is all this function without some purpose.13 Since the involuntary autonomic nervous system is steadily transmitting from viscera-which includes the cardium14-to cortex, and any "stimulus produces neural perturbations that invade all brain structures,"15 while "no subsystem of the brain is ever completely inactive, even in deep sleep,"16 the full scope of elementary cardiac activity, specifically its vibratory aspect, becomes doubly critical . . . perhaps preconsciously, then subliminally. What better instrumentality for epigenetic intent-purpose which apprehends itself-than a governor right within the organism, advising brain as well as body how to behave and learn? How pertinent for vertebrates that the nervous system's growth is predicated forthwith on cardiac function.17 Or, more tantalizing to us, "initiation of the ontogenesis of behavior . .. begins with those irregular contractions of the cardiac muscle . . ."18 At this inceptive instant, it would not be exaggeration to claim the embryo is all heart. With variable beats ranging from 130 to 140 per minute, the embryological and then fetal heart is joined in a veritable symphony via those very senses it vitalized ... by the mother's counterpart at slower rhythms spanning 70 to 80 counts a minute. In parenthesis, the common onomatopoetic expression of heartbeat as "lub-dub" should read "lub-dup," to accurately reflect that sharp closure of the aortic and pulmonary valves.19 Thus the embryo's solo might seem shortly seconded by a maternal-fetal duet; past the preconscious primer, an advanced level of local tutoring would appear to arrive as in utero audition develops. Presumably its second trimester already sees the unborn a graduate student. But is this twin instruction really what reverberates in the uterine classroom? Any adult who has had the indelible experience of hearing Murooka's recording, Lullaby from the Womb, 20 might have cause to disagree: single hemal pulses rushing down the aorta outside an adjacent placenta, in conjunction with similar thrumming from the adjoining aortic vein as well as this same flow surging through umbilical blood vessels-accompanied by various fluids in motion-all contribute to a distinctly monosyllabic rhythm, captured hydrophonically, much like a sewing machine treadle or accelerated surf (even rapidly passing trains, source of Doppler's original observation) of astonishing volume; never will brainwashing figure so formidable. In fact, it is this particular sonoral signature which evokes significantly stronger reaction from the infant in postnatal tests than that discerned by stethoscope or doptone.21 While some authorities maintain the bifurcated beat impressionably present,22 a problem obtrudes: Which cardiac pattern is of primary in utero influence? Fortunately, the issue tends to resolution when posed sequentially; because preconscious stimulation of cortical cells may transpire embryologically, or at least prior to function of the fetal auditory sense, a prenate's own paired pulses-as detected by its increasingly attentive brain-become the initial imprinting agent, succeeded in descant by monotonal aortic influence of the gravida, placentally proximate and peaking at 95 decibels, or in chorus with her heart's more subdued double drumming. And what has this indigenous if phased educational system taught? Beyond hypothesis, the evidence of prenatal pattern appreciation expressed through musical preferences cannot be discounted: fetal fondness for Vivaldi and Mozart, as opposed to marked dislike

whenever the orchestral pieces of Beethoven or Brahms are played,23 would seem to verify that specific sound configurations can elicit pleasurable infant (as well as adult)24,25 responses, conceivably because they are recognized as variations of the rudimentarily familiar, comforting, secure. Remove compositional theatrics-those connoisseur delights in chording, harmonics, or instrumental flourishes-from classical scores, and each remnant skeleton approximates the sinusoidal wave form as well as tempo of that universal tune whereby all babies are reassured26. . . the heart's steady song, Ur-text in which is written the outline for perhaps every vertebrate's lifestyle. And though the neonatal attention span may average but twelve minutes27 (auditorily somewhat longer in the womb because other distracting sensory data is muted), as proposed before, cardiac instruction could continue covertly after the preconscious period-since neural structure, prompting our tautological unconscious, might indeed have a mind of its own . . . enjoying discrete, unlimited receptivity to rhythm. We know the positive effects of gentling on animals; can it be said heartbeat acts like a sonoral stroker without peer? Yet what to make of that refreshing ethical behavior specifically emerging in prenatally motivated children?28 If, as recently advanced by Libet,29 the involuntary mind triggers impulses to perform in accord with preset arrangements, and such intricate architecture is firmly erected upon a fond foundation-esthetically elegant-our deeds must reflect an attendant psychological spread, demonstrating propensity for harmony over discord, pleasure instead of pain, healing rather than harm (at least relatively so, compared with animal antecedents). Occurring prenatally, then, in the singularly impressionable, supremely formative cerebral stage, any persistent pattern (most probably conducted interoceptively throughout the embryo from its heart, definitely with fetal auditory function monitoring maternal cardiac rhythm) affects the appropriate neurological receptors in what amounts to an archetypal taxis-reflexive orientation by a free agent which becomes fixed in reactive modality and matrix. Once the postulative, paradigmatic first brain cell is so coordinated, it prejudices the second like interfacing crystals or the marriage of molecules: an inclination for morphological growth proceeds, the cognitive cartographer begins to map. In scrupulous consequence, therefore, by dint of prelearning, only those incremental variants to the initial, dominant message can be perceived, hence all other data will merely pass without appreciation, sieved from lack of recognition, screened for elemental sense. As definitively and despotically as Old Testament mandate, neurological logos is laid down according to heartbeat-the beginning word-whose psychodynamics are a vast, uncharted territory; one obvious example would be to explore whether preterm infants have reduced mental skills and thus slower motor functions because they have been deprived of their maternal structuring mechanism, implying that fetal cardiac resource may be insufficient as an imprinting means late in gestation. However, when those current intervention programs which before birth employ but repeated verbal monosyllables or snatches of complex musical selections, each masking the heart's underlying stratum, are already producing children who strain the upper limits of accomplishment and credibility,30 procedural improvement must intrigue: What if prenatal enhancement were attempted with sonoral patterns progressively sequenced from the cardiac precedent, over appropriate imprinting periods? Further, though auditorily more effective throughout the final trimester, were this exposure to transpire not only at the original indication of consciousness but also during that narrow preconscious neurological opening when elementary yet seminal programming is taking place as brain growth first accelerates, would the organism be availed of optimal opportunity for maximizing its potential before life's sole such occasion vanishes? Biologically encoded and culturally enriched neuronal relationships in man may be prenatally poised for that crucial stimulus which evokes ultimate aptitude, quantitative change proving qualitative, the immune system catalyzed homeopathically. CURRICULAR CRITERIA Two kinds of information impact the in utero child: disorganized and ordered; as emphasized, apprehending the former must in some measure relate to if not seem epigenetically determined by the latter, thus heartbeat-the only disciplined contender for prenatal primacy (excepting brain waves, whose uterine accessibility poses imponderable problems for the moment)-can be considered an absolute baseline, everpresent referent. . . demonstrated by the efficacy of its enduring postnatal effect. However, before any prenatal auditory lesson plan is formulated, general operational requirements should be

outlined: 1. Effective Signals Primary acoustical components might attend specific in utero developmental levels, whether embryological or once sensory reception has matured whereby rudimentary cognition is present, mindful that the ideal time for commencing stimulation will become known only from longitudinal studies. Given the gravidic abdomen's transmission capability and a precautionary desire to not physically involve the uterine cavity, all sonoral intervention should originate externally. Electronic synthesis with the new digital sampling devices can assure fidelity of cardiac transcription by obeying a simple formula: x - y = z, where x is an originating ex utero sound, y the known tissue and fluid attenuation factor (as determined by in utero hydrophone), and z the resultant stimulus conforming to those blood pulse parameters recorded in the womb. a. Pitch. Sound stimuli must fall within fetal hearing range, fixing the heart's frequency as a middle C for consciousness; presumably, preconscious receptivity ought not to be dissimilar, having no other native imprinting standard, though probably most receptive to rhythm sensed viscerally rather than tonal shifts. Still, because an organism may adhere to whatever patterns are first made available, despite their format, a question worth abstractly entertaining: Could flute or French horn replace the conventional cardiac register-mouth harp, musical saw, birdcall, laughter? Starting at so vulnerable a point, it would seem far more safe to duplicate the eventually familiar hemal imprint; for lifetime dimension of positive design, early homeostasis may be best influenced by benevolent change, ultimately expanding individual choice from a secure base. b. Tone Length. Duration of sonoral units sufficient for embryological coding and fetal recognition, attracting attention without inducing boredom, can approximate their respective cardiac cues. c. Volume. An optimum signal ought neither to startle beyond arousing fetal curiosity, damage prenatal hearing, nor disturb the mother; during the preconscious period, it must be of such magnitude as to register neurologically. Again, the heart's decibel level is presumably an effective precedent if coordinated with the sonoral conductivity of intervening matter, as confirmed hydrophonically. Signal strength meeting these criteria should ideally not require coupling gel between transducer and the maternal skin surface. d. Rate. Acoustical repetitions corresponding to that growth stage when administered might maintain normative prenatal speeds of 130 to 140 counts per minute during the first trimester and the maternal average of 70 to 80 (even as slow as 60 resting beats) when fetal hearing evolves, or prudently opt for the latter throughout gestation. However, as before though best limited to animals, testing can ascertain efficacy of a feverish staccato versus turgid swells, possibly resolving whether rhythms markedly different from heartbeat would produce noticeably more pedestrian or accelerated creatures. 2. Overstimulation Avoidance As Ludington points out,31 there is only a solitary instance in professional literature expressing contrary concern-with that merely raising the question-and if omnipresent cardiac vibration is either automatically dampened or instructs subliminally during fetal sleep and preconscious assimilation periods, continuous stimulation may not pose problems; obviously, beyond being structured thus for life as it has presently evolved, the prenate is not excessively engaged, therefore unconscious screening of stimuli based on precedent-that which avoids neurological overload as determined by exposure to imprinted data-would seem its natural defense. Also, given a veritable dearth of in utero rhythmic resources except heartbeat, developing neural networks may be virtually starved for vital information-whatever will culturally reinforce their genetic architecture in order to survive biologically ordained die off. Initial trials, though, should observe the careful, common sense approach, building to their maximums as warranted by postnatal tracking. 3. Form Intensive Attending prenatal learning's morphological character described above, verbal content of signals should defer to a strictly sonoral vocabulary, emphasizing pattern by emulating the heart's lexicon, where meaning is reserved for its appropriate developmental theaterthe world after birth. 4. Universal Voice Avoiding adult gender or language group prejudice may be accomplished by cardiac simulacra generated synthetically, from their like substance and duration of sequences no less embodied though perhaps, if continuous, even more intimate than maternal vocalization. Again, rationale for this and other features listed herein figures upon probable neurogenetic coding, whereby exclusive receptivity to the heart's imprints is seen fixed as cellular division and migration. 5. Incremental Variety To engage prenatal interest while epigenetically constructing neurological

order, increasingly involved patterns should be employedeach slightly varied from its predecessor and introduced at rates whose effectiveness will become known through testing-at least in initial trials; what positively excites and thus encodes neurons may in fact prove changeability beyond present assumption, requiring quite rapidly alternating input, but this depends upon how much information the early organism might safely absorb . . . which only detailed experimentation can discern. 6. Environment Equal For copying with peri- and neonatal conditions-complex human surroundings-the prenatal infant ought to have received all optimally usable data by birth, meeting the vital criteria that insure maximum brain cell viability. According to the above methodological parameters, specific curricular protocols and their application prove axiomatic. PROJECT PRELEARN If that internal mechanism which first imprints being were exactly known, we could assign a relevant hierarchy without hesitation; while not the precise case, options are nonetheless limited. Although the mother's monotonal aortic pulse-as manifested in the placental neighborhood-is basically a calming rather than excitative stimulus32 despite local volume, the problem of choosing between single versus double beats (perhaps registering from the prenate's own heart) for an initial neurogenetic supplement could be addressed by simply emphasizing their distinctive difference: commence shortly after the infant's cardiac onset from former to latter, reinforcing both familiar references before providing an extended family; the possibility of preconscious neuronal influence must be balanced with knowledge when fetal audition begins (in the fourth month)33-thus sensitive to single and double cardiac patterns-against greatest miscarriage vulnerability through the earliest trimester. These concerns notwithstanding, opposed to other candidates lub-dup alternatives are advanced as the likeliest direction for original testing-following duplication of native instruction no matter when administered in utero. Starting with one repeated note before departing the binary signature of all healthy human hearts (like poetry's metrical feet, acoustically reflecting stressed or unstressed accents), grammatical principles of signal modification, both from the prenatal/maternal baselines and immediately previous variant, might include addition, omission, substitution, reversal, and alternation-along with different pitches after infant audition commences, safely assumed by midgestation; most structural and inflexive linguistic processes operate in similar fashion. Once the basic cardiac quantum of information-the gravida's aortic blood pulse passing her placenta-is arbitrarily given a letter designation, for example, A (compared with its double embryological/fetal counterpart being signified preconsciously by AA, or variable-tone imprint following the advent of hearing indicated as AB), an amplified lexicon can evolve. Whether one specific signal should be trailed by another equally unique is less important that that the variants be minimally different, exciting interest without failing recognition or frightening, yet repeated over periods effective in promoting strong dendritic growth, the arborization which matters for stable synaptic interfacing. Bricks can be laid in diverse relationships, some structurally superior, but in lieu of exact knowledge about the ideal, novice efforts should solidly pave the prenatal street, not erect a postnatal wall; we will only be employing local material, that curriculum already present, as though the heart itself were communicating better, sending more detailed instructions. What follows is just one sample trying to meet those aforementioned strictures, a preliminary pass at discerning the cipher which might unlock encrypted human potential. Even so, while partially successful, other approaches do not admit a zero-based protocol incorporating that primary paradigm to which all subsequent influences must conform or remain unregistered. Next to these ten descendents of the two preconscious cardiac progenitors (A and AA) are listed each grammatical principle they exemplify-some affecting stroke, others an entire foot; C represents a pitch removed in both time and tone from B the degree B distances A. Every alternate exposes the unborn to what could be countenanced a new heart, in essence creating another head, while together an incalculable committee. If impossible for adults to imagine the in utero effects such patterns would have over extended durations-since we bear a bias of comparative cognition the prenatal infant wholly lacks-it may help by voiding the mind and, for only a minute, sounding in any key the mantric combinations, though an exercise perhaps less science than art.

THE CARDIAC CURRICULUM©

	Sonoral variants (tonal shifts after lesson 6)							Patterning processes (change from previous signal)
(1)	A	A	A	A	A	A	A	Maternal aortic heartbeat baseline
(2)	AA	AA	AA	AA	AA	AA	AA	Embryological/fetal heartbeat baseline
(3)	A	AA	A	AA	A	AA	A	Omission, alternation
(4)	A	AA	AA	A	AA	AA	A	Omission, addition
(5)	A	A	AA	A	A	AA	A	Omission, reversal
(6)	A	A	AA	AA	A	A	AA	Omission, addition
(7)	AB	AB	AB	AB	AB	AB	AB	Addition, substitution
(8)	BA	BA	BA	BA	BA	BA	BA	Reversal
(9)	ABA	ABA	ABA	ABA	ABA	ABA	ABA	Reversal, addition, alternation
(10)	BAB	BAB	BAB	BAB	BAB	BAB	BAB	Reversal, substitution
(11)	ABC	ABC	ABC	ABC	ABC	ABC	ABC	Reversal, addition
(12)	ABC	CBA	ABC	CBA	ABC	CBA	ABC	Reversal, alternation

Not insignificantly, by this progressive series of a dozen steps an elementary musical scale is achieved-but a tune with supreme potential, like ABC's in some unworldly yet oddly related alphabet. At which prenatal point should instruction begin, its lessons lasting how long? If the heartbeat baselines constitute operational frameworks whose behavioral consequence subsumes what is demonstrated herewith, could contributing but a second informational program increase, perhaps double the number and/or value of surviving neurons? (Apparently, twins-or other multiples-only reinforce and do not enhance the heart's basic rhythm.) As indicated earlier, if preconscious imprinting pertains, intervention by synthesized rendition of the maternal pacemaker (A) would become the infant's secondary caregiver, coinciding with inception of cardiac activity three weeks after conception; such a sequence of twelve, then, might change individual lessons every three weeks for the full term. This same format could be applied weekly over the last trimester by a mother belatedly learning of the method, presumably to lesser effect. An inexpensive, portable, audio cassette player-accepting only cardiac curricular tapes-employing fixed tone, volume (to prevent fetal hearing impairment), and automatic shutoff or repeat function regulated by a timer set manually, clipped to clothing at the waistline, with a small monaural or binaural transducer positioned near the placenta, can readily afford singular opportunity even in developing countries, where illiteracy should be no barrier if controls and cassettes are color-coded with pictorial descriptions; instructions and precautions (such as periodically listening to each tape for malfunction) could be adjunctive to local family planning services. Bridging technologies, an alternative transducer compatible with existing player models might feature selfcontained loudness and frequency ceilings. A further patenting advancement utilizing integrated circuitry-like that miniature unit in musical greeting cards-powered from solar crystal or cadmium cell, with all lessons digitized on a single microchip and selected among their numbered series by switch (even preset to progress through the entire sequence), would reduce size if not price, affording greater ease of handling; future improvement might offer a maternal biochip implant. And although the normative female voice range (to which prenates show heightened response) could prove an effective pitch against uterine noise masking, because of the relatively low sonoral frequencies involved, unlike ultrasound technology none of this equipment produces radiation levels more significant than that generated by the body

itself. Currently undertaken as Project Prelearn by the Prenatal and Infant Education Institute in conjunction with several organizations, daily administration of heartbeat variants over minutes to hours-including continuous operation-for a broad maternal socioeconomic spectrum and tracked longitudinally, will narrow the protocol to where production of the specifically modified audio player (designed in 1982, with 1985 patent applied for)34 and copyrighted Cardiac Curriculum can proceed under the trade names Babyplayer and Babytapes, technical components of a generic prelearning process marketed as The Prelearning Program, whose unborn participants are prelearners.* For curricular reinforcement and progression, an interchangeable sound amplifier at cribside could avail the infant of additional grammatical levels through its first two years to capitalize on the second period of brain growth; continuity would be achieved by repeating the Cardiac Curriculum's last lessons, then simple, unchorded melodies and the major international language patterns introduced for promoting later facility-since we know any tongue's early familiarization remarkably speeds its formal acquisition even in adulthood35-undoubtedly enhanced among the prenatally stimulated as opposed to those not equally benefitted. Evaluation should span full neonatal scoring (Apgar, Brazelton, other perception and motor inventories), regular parental reports of sibling/peer comparison to age one, annual standardized tests until school data begins, as well as subject responses thereafter-especially since prelearners may wish to establish contact within their own network. Made available to practitioners, maternal care providers, hospital staffs, parent eduction services, and through extensive advertising, The Prelearning Program would strongly encourage public feedback for longterm followup, all records databased. Additionally, because prenatal auditory stimulation predicated on heartbeat is not content-oriented and neurological growth speciesrelative, application to animals where their respective cardiac alternatives are amplified in the cage during gestation-though after birth for vertebrates where the critical brain spurt so occurs36-is being pursued, with postnatal testing, such as water or T-mazes, for change in reaction times and skills; subaquatic administration via hydrophone for pregnant dolphins might also prove worthy of exploration. Naturally, mutable aspects of consciousness at any level would raise interesting questions, ethical no less than pragmatic: Does the world want a smarter rat? Negative results from this research, however, need not inhibit human study, since the neurogenetic occasion for opportunity may be concentrated only with higher orders, and, phylogenetically, "as a system matures, it uses increasingly effective codes. . . ,"37 If our formative signals seem elementary, they keep conveying meaning-like the lub-dup syllables of these very words. SUMMARY To recapitulate this momentous and monumental development in local consciousness: 1. Prenatal instruction, advancing piecemeal over the twentieth century, has now become an applied science, however unformulated. 2. Even limited application of its various techniques is producing children whose nomothetic sensory abilities, mental powers, artistic talents, social skills, motor functions, and behavioral traits, culled idiographically, are far beyond those of their disadvantaged peers-faculties which do not appear to diminish with age, unlike intensive neonatal learning programs. 3. Consideration of the sonoral factor common to these approaches, coupled with recent neurogenetic and imprinting discoveries, specifically suggests heartbeat as the paramount in utero stimulusprobably by multisensory means including the cutaneous if not visceral, both promoting and patterning preconscious cerebral growth as soon as three weeks' gestation, preceding conscious influence after fetal hearing develops. 4. Since auditory stimulation has proven the key to early neurological health yet the vast majority of brain cells become nonfunctional shortly before birth-while children who have received prenatal sensory enrichment are exhibiting what can be held the reverse of this reductive process-an exclusive connection between the demonstrated prime imprinting mechanism and postnatal achievement is drawn, from which advantage can be taken during the main chance for neuronal retention and organization. 5. By construing the cardiac precedent to be our foremost structuring principle, vibratory and/or auditory departures from it are posited as grammatical units. 6. Through offering such incentive to the unborn by digital sampling device signals-transcribed on cassette tapes for use in an operationally preset portable audio player or as microchip circuitry with miniature battery and transducer situated over the gravida's abdomen-it is proposed that prenatal neurological aptitude hence lifetime performance will be significantly

increased. 7. Public access to prenatal auditory learning can be achieved via marketing in economically developed nations and as an institutionally subsidized component of reproductive programs in Third World countries, raising the probability of species optimization. Obviously, many questions about prenatal stimulation abound-both substantive and technical-yet at this juncture they ought not to impede vital investigation which will surely answer them. When that happens, other issues shall doubtless arise, though better skills than our should be available for their resolution . . . talents generated, quite probably and literally, from the heart. Footnote * Project Prelearn's first subject-stimulated for two hours daily over seven months, with a new sonoral sequence every week-was born in July 1987, exhibiting those characteristics common to infants advantaged in utero (see reference note 30). References REFERENCES 1. Verny, T. (1981). The secret life of the unborn child, (p. 28) New York: Dell. 2. Brooksbank, B.W.L. &Balazas, R. (1981). Aspects of the biochemical development of the brain. In K. J. Connolly, H. F. R. Prechtl, (Eds.), Clinics in Developmental Medicine 77-78. (p.133) Philadelphia: J. B. Lippincott. 3. Hofer, M. (1981). The roots of behavior, (p. 147) San Francisco: W. H. Freeman. 4. Salk, L. (1962). Mother's heartbeat as an imprinting stimulus. Transactions of the New York Academy of Sciences, 24, 761-762. 5. Salk (1962). (pp. 755-756). 6. Salk (1962). (pp. 756-757). 7. Salk (1962). (pp. 757-761). 8. Murooka, H. (1975). Lullaby from the womb. Notes in Lullaby from the womb (1974, record), (pp. 2-4) Hollywood: Capitol Records. 9. Grier, J. B., Counter, S. A. &Shearer, W. M. (1967). Prenatal auditory imprinting in chickens. Science, 155, 1692-1693. 10. Ludington, S. (1985). Infant stimulation (audio cassette). Presentation at the Day One Training Program, Seattle. New Horizons for Learning, P.O. Box 51140, Seattle, Washington 98115, USA. 11. Hofer (1981). (p. 89). 12. Hofer (1981). (p. 89). 13. Hofer (1981). (p. 88). 14. Boddy, J. (1983). Information processing and functional systems in the brain. In A. Gale, J. A. Edwards (Eds.), Physiological correlates of human behavior, (pp. 69-71). New York: Academic Press. 15. Boddy (1983). (p. 73). 16. Boddy (1983). (p. 73). 17. Hofer (1981). (p. 90). 18. Kuo, Z. Y. (1976). The dynamics of behavior development, (p.160) New York: Plenum Press. 19. Heart sound. Encyclopaedia britannica (1978). Chicago: Encyclopedia Britannica, IV:977. 20. Murooka (1974). 21. Murooka (1975), (p. 3). 22. Verny (1981). (p. 28, 38). 23. Verny (1981). (p. 21, 39). 24. Rosenfeld, A. H. (1985). Music, the beautiful disturber. Psychology Today, 22:51. 25. Liley, A. W. (1972). The foetus as a personality. Australia and New Zealand Journal of Psychiatry, 6, 104. 26. Salk (1962). (pp. 757-761). 27. Ludington (1985). 28. Fritz, D. (1985). A prenatal approach to maximizing human potential: the work of Igor Charkovsky in Russia (audio cassette). Presentation at the second International Congress on Pre and Perinatal Psychology, San Diego. The Pre and Perinatal Psychology Association of North America, 36 Madison Avenue, Toronto, Ontario M5R 2S1, Canada. 29. Libet, B. (1985). Unconscious cerebral initiative and the role of conscious will in voluntary action. The Behavioral and Brain Sciences, 4, 529-566. 30. Logan, B. (1986). Learning before birth: the cardiac curriculum. Presentation at the First Developmental Enrichment Conference of the Infant Stimulation Education Association, Costa Mesa. Prenatal and Infant Education Institute, 2000 Lake Street, Snohomish, Washington 98290, USA, 5-6. 31. Ludington (1985). 32. Murooka (1975), (p. 3). 33. Verny, T., Collier, S. (1986). Baby chart. Notes in Love chords (audio cassette). Scarborough: Ontario, A &M Records. 34. Logan, B. (1985). United States Patent Office serial number 06/784.201. 35. McAuliffe, K. (1985). Making of a mind. Omni, 1; 64. 36. Dobbing, J. (1974). Human brain development and its vulnerability. Biologic and clinical aspects of brain development, 6, 6-7. Mead Johnson Symposium on Perinatal and Developmental Medicine. 37. Miller, J. G. (1978). Living systems, (p.98) New York: McGraw-Hill. AuthorAffiliation Brent Logan, Ph.D. Prenatal and Infant Education Institute AuthorAffiliation Excerpted from Learning Before Birth: The Cardiac Curriculum, presented at the First Developmental Enrichment Conference of the Infant Stimulation Education Association, UCLA Center for the Health Sciences and Georgetown University, Costa Mesa, California, March 14, 1986. Address reprint requests to Brent Logan, Ph.D., 2000 Lake Street, Snohomish, WA 98290.

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