administration (*2*) and because calcitonin in the plasma increases after a meal (*14*), we suggest that calcitonin is partially responsible for inhibiting gastric acid secretion at the end of a meal.

The mechanism by which calcitonin alters central nervous system function is unknown. Myers *et al.* (*15*) have shown that feeding can be produced in the satiated rat by increasing the concentration of calcium in the brain. Recently, we have found that feeding induced by calcium chloride in the rat is inhibited by concomitant administration of calcitonin (*8*). In addition, using a hypothalamic explant culture system, we showed that calcitonin depressed $^{45}Ca^{2+}$ uptake at doses equivalent to the intraventricular doses that suppressed feeding and gastric acid secretion (*8*). It is thus tempting to speculate that calcitonin may produce its effects on the central nervous system by altering neuronal calcium fluxes.

The studies reported here together with those previously reported on the effects of calcitonin on food ingestion and on hypothalamic calcium fluxes strongly suggest a neuromodulatory role for calcitonin in the maintenance of hypothalamic activity. Thus, calcitonin should be added to the long list of peptides that play a role in integrating the hypothalamic functions responsible for the maintenance of the *milieu intérieur* (*16*). With the widening acceptance of the concept that calcitonin is a neuroactive hormone, it would not be surprising to find that it produced a number of other effects on the central nervous system.

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Physical and Social Environment of Newborn Infants in Special Care Units

Abstract. *Infants in newborn intensive and convalescent care units are exposed to large amounts of sensory stimulation of various sorts. Although infants in these units do not lack visual, auditory, and tactile stimulation, they receive relatively infrequent coordinated sensory experiences. Furthermore, there is no diurnal rhythmicity in physical and social stimulation across days.*

Modern medical management has reduced neonatal mortality and morbidity. However, longitudinal investigations indicate that deficits in cognitive and sensory functioning persist as a major problem in the development of premature infants (*1*). Researchers have recently proposed that the intensive care unit, the environment in which many premature infants spend their early weeks, is not conducive to optimal development. Several investigators have hypothesized that the intensive care unit provides an environment that is inadequate in amount and pattern of stimulation (*2*). Contrary to this view, Cornell and Gottfried (*3*) contended that as a consequence of the personnel, equipment, and activity present in modern intensive care units, premature infants may be exposed to large amounts of sensory stimulation of various sorts. Lawson *et al.* (*4*) have suggested that premature infants in intensive care may suffer not from an inadequate amount of stimulation but from a disjunctive pattern of stimulation. Lucey (*5*) and Korones (*6*) have argued that intensive care may have become too intense and may be responsible for newly recognized iatrogenic complications. We now report an investigation of the quantity, quality, organization, and diurnal rhythmicity of physical and social stimulation in a special care unit for newborns in a major medical facility.

The study was conducted at Los Angeles County–University of Southern California Medical Center Women's Hospital. Observations were conducted in designated locations in the newborn intensive care (NICU) and convalescent care units (NCCU). Each unit houses between 18 and 25 infants. Three 1-minute observations in each unit were conducted at the same time every hour for 24 hours over three nonconsecutive days (two weekdays and one weekend day). For each observation, one researcher recorded physical and the other social data. The physical data included illumination levels (Gossen Luna Pro light meter), characteristic and peak sound levels (Bruel & Kjaer sound meter 2203), a frequency analysis of the sound spectra (Bruel & Kjaer octave filter set 1613), and occurrence of speech, nonspeech, and radio sounds (Table 1). These data were collected in operating incubators by means of the light and sound meters and by a tape recorder. The social data included the frequency of medical or nursing care, bottle-feeding, social touching, rocking, and talking when in contact with an infant; we also noted whether the infant was in a position to see the care giver (vision). Interobserver reliabilities for all physical and social variables exceeded 97 percent and 92 percent agreement, respectively.

The data base included a total of 405 recordings for each physical variable and 1551 observations of infants, of which 292 (18.8 percent) included social contact (*7*). There were no significant differences among the 3 days in the magnitude or frequency of events. Ambient cool-

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white fluorescent lighting was always present with little variation. The highest levels recorded were during midafternoon hours, probably because sunlight entered through windows. Sound levels averaged between 70 and 80 dB (linear) (*8*). The overall noise environment was comparable to light auto traffic and at times reached that of large machinery (*9*). Sound levels fluctuated continuously. High levels were not impulsive, but were evaluated for durations of 4 to 6 hours. With the exception of illumination levels and percentage of nonspeech sounds, values in the NICU were higher than those in the NCCU (for parametric variables: $t \geq 3.33$, d.f. = 403, $P < .01$; for nonparametric variables: $\chi^2 \geq 7.37$, d.f. = 1, $P < .01$). The frequency analysis of the sound spectra taken at each octave band from 31.5 to 32,000 Hz revealed that the acoustic environment of newborn special care units was characterized as high intensities at low frequencies. For each physical variable (except sound spectra) Kendall's coefficient of concordance was used to test for diurnal rhythmicity across the 3 days in each of the two units. This analysis revealed no temporal stability on any of the variables ($W \leq .51$, $k = 3$, $j = 24$, not significant).

The light and sound recordings in the incubators presented a virtually identical picture to the recordings in the units proper. Speech as well as nonspeech sounds were picked up on all tape recordings. These data indicate that the visual and auditory stimulation in the units is continuously available to neonates in the incubators.

Medical or nursing care and talking occurred significantly more often in the NICU than in the NCCU ($\chi^2 \geq 8.56$, d.f. = 1, $P < .01$) whereas bottle feeding, social touching, and rocking occurred more often in the NCCU ($\chi^2 \geq 19.00$, d.f. = 1, $P < .001$). Handling was a variable generated to provide an index of the occurrence of tactile stimulation. Kendall's coefficient of concordance was also conducted on each social variable to determine whether there was diurnal regularity across the 3 days in each of the units. The results showed no temporal consistency on any of the variables ($W \leq .47$, $k = 3$, $j = 24$, N.S.).

In addition to studying the occurrence of individual social events, we ascertained the co-occurrence of social events with talking and vision to determine the frequency of sensory coordinated or integrated experiences received by the infants (for example, being handled and talked to simultaneously). Compared with the magnitude of visual, auditory, and tactile stimulation, coordinated experiences occurred infrequently (Table 2).

Our findings do not favor the hypothesis that infants in special care units are sensorily deprived. Illumination varied minimally and was monotonous throughout 24 hours. Although we do not know whether prolonged continuous cool-white fluorescent lighting has adverse consequences on premature infants, a considerable body of evidence with infrahumans as well as with children and adults indicates that such lighting conditions do have negative biochemical and physiological effects (*10*). Research addressing this issue as well as the synergistic effect of the vibratory phenomena of light and sound on infants in special care units is needed.

Sound levels at times were excessively high and potentially hazardous. Infants were exposed incessantly to nonspeech and most of the time to speech sounds. Infants in incubators were neither sheltered from these sounds nor were there periods in which auditory stimulation ceased. In view of epidemiological findings and continuing reports on the association of prematurity and hearing impairment as well as studies indicating a relationship between intensive noise levels and extra-auditory effects in young infants and children (*11*), greater attention should be directed toward reducing noise levels in newborn special care units (*12*).

The occurrence of handling in the NICU and NCCU was equivalent and was devoted primarily to medical or nursing care. Although it is difficult to judge the degree of tactile stimulation received by the infants, new findings relying on transcutaneous oxygen monitoring have shown that handling infants for medical or nursing purposes in intensive care units may result in transient hypoxemia (*13*). The implications of these findings is that any handling may be deleterious and unnecessary handling should be avoided when infants are in the NICU. On the other hand, the occurrence of rocking in the NCCU was sur-

Table 1. Physical and social data.

Variable	NICU	NCCU
	*Physical variables**	
Illumination levels (lumen/m^2)		
Mean	530	508
Range	344 to 1400	243 to 1400
Sound characteristic (dB)		
Mean	77.4	74.5
Range	66.0 to 109.0	62.0 to 109.0
Sound peak (dB)		
Mean	85.8	82.0
Range	69.0 to 118.0	65.0 to 118.0
Speech (%)	92.2	69.2
Nonspeech (%)	100.0	100.0
Radio on (%)	79.4	54.2
	Social variables†	
Medical or nursing care (%)	15.5	3.8
Bottle feeding (%)	0.02	8.5
Social touching (%)	0.02	5.8
Rocking (%)	0.001	2.6
Handling‡ (%)	17.8	15.3
Talking (%)	13.0	7.9

*For each physical variable there were 204 and 201 observations in the NICU and NCCU, respectively. †Total social observations: NICU, 846; NCCU, 705. ‡Handling is defined as the occurrence of one or more nontalking social contact during a single observation of an infant.

Table 2. Simultaneous occurrence of social events with talking and vision as percentages of total observations.

Social event	NICU			NCCU		
	Talking	Vision	Talking and vision	Talking	Vision	Talking and vision
Medical or nursing care	7.9	8.0	3.8	1.8	2.3	1.3
Bottle feeding	1.1	1.2	0.6	2.8	7.0	2.6
Social touching	1.7	0.9	0.9	3.7	4.3	3.1
Rocking	0.1	0.1	0.1	1.1	2.1	0.9
Handling	9.6	9.6	4.8	7.2	11.7	5.5
Talking		7.1			5.4	

prisingly low in view of the number of recent studies demonstrating that vestibular-kinesthetic types of stimulation facilitate development in young premature infants (*14*). Thus, when the condition of infants is stable, handling and rocking appear to be beneficial.

Although infants in special care units do not suffer from a lack of visual, auditory, and tactile stimulation, they have relatively little coordinated or integrated sensory experience. Although the long-term effect of these dissociated sensory experiences is unknown, this finding is significant in view of recent evidence showing a deficit in the ability of premature infants up to 1 year of age to integrate tactual-visual sensory information (*15*).

The data also reveal that diurnal rhythmicity across days on physical and social variables was not a characteristic of newborn intensive and convalescent care units. Environmental engineering for special care units may prove necessary for preventing many iatrogenic problems and promoting development of premature infants.

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Hypothyroidism Elicits Electrophysiological Noradrenergic Subsensitivity in Rat Cerebellum

Abstract. *Discharge rates of Purkinje neurons were compared in control and hypothyroid adult rats. Purkinje neurons in hypothyroid rats fired significantly faster and were less sensitive to iontophoretically applied norepinephrine than those in control rats. The subsensitivity of the Purkinje neurons appeared to be primarily due to an alteration in the β-receptor–adenylate cyclase complex, because the sensitivity of these cells to locally applied N^6-monobutyryl adenosine 3',5'-monophosphate (N^6 cyclic AMP) did not change significantly. The sensitivity of the Purkinje neurons to norepinephrine could be restored in hypothyroid rats by administration of triiodothyronine.*

Hypothyroidism elicits a state resembling adrenergic hypoactivity (*1–5*). In hypothyroid rats, a reduction in the norepinephrine-induced accumulation of adenosine 3',5'-monophosphate (cyclic AMP) in the central nervous system (CNS) and a decreased β-receptor density have been reported (*3*). However, few electrophysiological studies have been conducted on identified neurons during hypothyroidism (*6*). The cerebellum offers several advantages as a test system for this type of study. The rate of discharge of the Purkinje neuron (the principal cerebellar neuron) is controlled by a direct norepinephrine-containing pathway from the pontine nucleus locus coeruleus (*7*). Norepinephrine released from the locus coeruleus neurons inhibits the activity of Purkinje neurons in a manner that may involve β-adrenoceptors and the generation of cyclic AMP (*8*). Since the responsiveness of some adrenergically innervated tissues is altered during hypothyroidism, and because the Purkinje neurons are a well-characterized model of central neurons receiving an adrenergic input, we made use of electrical recording methods and iontophoresis to characterize central electrophysiological manifestations of hypothyroidism. We now report that, in adult rats, hypothyroidism elicits an electrophysiological noradrenergic subsensitivity associated with the β-receptor–adenylate cyclase complex, and that this subsensitivity can be restored to normal by administration of the thyroid hormone triiodothyronine (T_3).

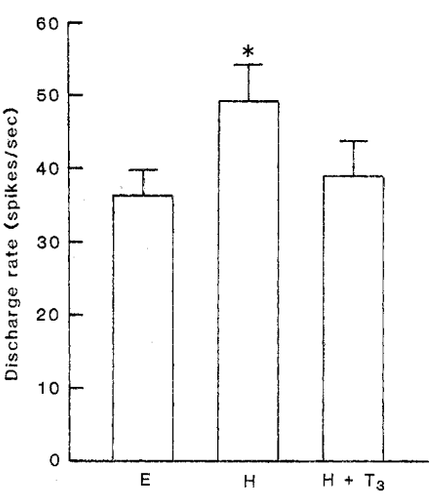

Fig. 1. Histograms of spontaneous discharge rates of cerebellar Purkinje neurons in euthyroid (*E*), hypothyroid (*H*), and hypothyroid rats treated with T_3 ($H + T_3$). Rats were made hypothyroid by feeding them 6-propyl-2-thiouracil (PTU) for 6 weeks as described by Nakashima and Hagino (*17*). The food (Altromin pellets) contained 0.15 percent PTU. During the PTU treatment the animals developed shaggy fur and showed reduced weight gain and diminished motor activity. To restore thyroid activity we injected the hypothyroid rats with 50 μg of T_3 per 100 g of body weight on alternate days for a total of three doses. Hypothyroidism produced a significant (*) increase in the spontaneous discharge of Purkinje neurons. Values (means ± standard error) were significantly different at $P < .05$ (*t*-test).

Electrophysiological data were obtained from 32 adult male Sprague-Dawley rats (200 to 280 g; Charles River). The rats were anesthetized with urethane (1.25 g/kg, intraperitoneally), and allowed to breathe spontaneously. Body temperature was maintained at 37°C with a heating pad. Recordings were made from Purkinje neurons in the vermis, lobules VI and VII, identified by ana-

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