A descriptive study was conducted to determine types and amounts of stimulation to five sensory systems of an infant that occurred as a result of everyday mother-infant activities. The infant studied was between 4 and 6 weeks of age. Results demonstrated that, overall, the baby received more tactile stimulation than any other type, followed by proprioceptive, auditory, visual, and vestibular stimulation. When activities were compared on a daily basis, feeding was found to provide the greatest amount of stimulation followed by playing, holding/carrying, bathing and changing. When compared on a per minute basis, playing was found to provide more stimulation than any other activity, followed by holding/carrying, bathing, changing, and feeding. The manner in which the various activities were carried out had a strong influence on the types and amounts of stimulation that resulted. Characteristics of both the infant and the mother appeared to be important influences on the types and amounts of stimulation the infant received. It was concluded that both mother and infant should be considered in planning therapeutic programs.

A central purpose of occupational therapy practice in pediatrics is to promote growth and development to the maximum, innate capacity of the individual (1). Traditionally, practitioners have implemented this purpose by providing activities and experiences chosen to fit the needs of the child based on age, stage of development, capabilities, and interests. Recently, occupational therapists have become involved in work with infants in their first weeks of life, and many view sensory stimulation as a developmental need of this age group. Several questions arise in relation to the provision of sensory stimulation within occupational therapy programs. What are appropriate types and amounts of sensory stimulation for weeks-old infants? Which activity modalities provide which types of stimulation? How can appropriate types and amounts of stimulation for any individual child be determined?

Most mothers are believed to provide adequate sensory stimulation for their babies in the course of their everyday activities (2). Careful observation of mothers and infants during everyday activities should provide answers to some of the questions regarding stimulation for young infants. The object of this study was to observe a mother and infant in their natural home setting and to document the types and amounts of infant stimulation that occurred as a result of everyday activities. Maternal and infant factors that appeared to influence the stimulation parameters were also investigated.

Review of the Literature
Today, young infants are believed to be capable of effective interaction with the world around them (3). In part, such interaction is based on infants' sensory capabilities. Their abilities to perceive and respond to stimuli have been shown to be more
mature than they were believed to be 10 to 20 years ago (2). Specifically, the tactile sense is highly developed at birth. Babies respond to a variety of tactile stimuli such as stroking and patting (4), pain (5), and cold (6). Also, the vestibular system is highly developed in the newborn as seen in infants' responses to rocking, being picked up (4), and to abrupt changes in body plane (3). Proprioceptive capacities are demonstrated in young infants by their responses to touch pressure, cuddling, or swaddling (7). Sounds also have been shown to have marked effects on babies within the first week of life (8-10). Visually, infants are able to fixate and follow moving objects (4) and can perceive different visual patterns. They have been shown to prefer more complex patterns, especially those representative of human faces (11). Overall, infants seem especially attuned to sensory stimulation from others. Korner (2) states that the stimulation to which infants are exposed at an early age may have a greater impact than formerly believed, since they are capable of perceiving and responding to a wide range of stimuli.

Research from the 1940s to the present has confirmed that sensory stimulation is important to the early development of all young mammals. Young rats (12-14), dogs (15), and monkeys (16) have been shown to develop abnormally in a variety of ways when deprived of sensory stimulation. Studies of humans demonstrated that babies deprived of sensory stimulation failed to grow normally in height and weight (17-19), and did not develop normally in motor milestones and in intelligence (20). Also, the social and emotional development of children may be affected by lack of stimulation in early life (21).

Research indicating that infant growth and development is influenced by early sensory stimulation has caused many child developmentologists to adopt a "the more the better" attitude toward sensory stimulation for young infants (7). Recently, however, some researchers have urged a more cautious approach and state that normal infants somehow "know" what types of stimulation are good for them. They give cues to their caretakers that indicate what they want and need. Sensitive caretakers read these cues and respond by supplying adequate stimulation in the course of everyday activities with their infants.

Mothers have been observed to stimulate their infants in very individual ways (10). A mother's personality, education, ethnic and cultural background, health (especially during pregnancy), and experience with babies influence the way she stimulates her child (22). Individual factors in infants, such as sex and age (23), birth order (24), and behavior (25), also have been observed to influence the stimulation the baby receives from the mother. These factors have been said to interact with or influence one another in a reciprocal manner.

Korner (2) and Schaffer (7) concluded that to be beneficial for an infant's growth and development, stimulation must vary over time and in response to the individual infant. Specifically, stimulation should be mild to moderate in intensity, should capture the baby's attention, and should promote a response.

Handicapped or immature infants may respond atypically to various kinds of sensory stimulation. In these cases, the reciprocal communication between mother and infant may break down (26). Children at risk for abnormal development from innate factors may be put at greater risk if they receive inadequate or inappropriate stimulation.

In several programs of sensory stimulation (or premature, atypical, or "at risk" infants, the authors reported that infants who were exposed to stimulating activities, such as radio playing, crib mobiles, fondling, rocking, and the like as part of their hospital care, grew and developed more rapidly than did infants whose care did not include such activities (27-29).

Studies in natural settings of mother-provided stimulation for infants are difficult to find. The primary purpose of this study was to observe and describe the stimulation an infant received as a result of everyday activities with the mother. Secondarily, the study examined maternal and infant characteristics that seemed to influence the stimulation. It was felt that clarification of these factors could be helpful to occupational therapists in planning therapeutic programs for infants.

**Method**

A case study design using systematic observation in a natural setting was chosen for this research to provide a detailed description and understanding of the individual mother and infant, their characteristics, and their everyday activities as providers of sensory stimulation for the infant. Case study is useful where many variables exist; in addition, it allows for comprehensive study of interrelationships among variables (30). The case study may bring to light new and important variables, processes, and interactions that deserve more extensive attention in subsequent research. Generalizations to a larger population, however, must be made with great caution (31).

**Subjects.** One healthy mother-infant pair, a 28-year-old volunteer...
mother and her 4- to 6-week-old daughter were studied. The mother grew up in an extended family that included grandparents, parents, and a younger brother. At the time of the study she was married, a college graduate, had worked as an elementary school teacher, and also had a 3½-year-old son. She was in good health.

The female infant had been born 3 weeks before the estimated due date. She weighed 5 pounds, 11 ounces at birth, and 9 pounds at the time of the study. She was breast fed. The mother described the baby as calm, happy, sweet, quiet, and easy to soothe, a slow feeder who loved to be held and who slept a lot.

Data Collection. The study was carried out in a series of visits during a 2-week period to the home of the mother and infant. Data were collected using a daily diary, videotapes, and interviews. The mother kept a 3-day, 24-hour-per-day record of her activities with her infant to document the order, frequency, and duration of activities. From this activity record, the mother and investigator together established which activities would be considered “everyday activities” for the pair. These included playing, changing, feeding, holding or carrying, bathing, and baby alone. Subsequently, three samples of each of the activity categories were videotaped for later analysis. Interviews with the mother and observation during activities were used to explore mother and infant characteristics that seemed to influence their activity patterns.

Data Analysis. The mother-infant activity record and interviews were used to derive a picture of the mother-infant pair’s “typical day.” The videotaped activity sequences were viewed repeatedly and analyzed to convert observed behaviors into types and amounts of sensory stimulation. First, a checklist of behaviors and types of stimulation (adapted from Greenberg’s typology of sensory stimulation categories) was used to categorize behaviors as providers of tactile, auditory, visual, proprioceptive, or vestibular stimulation; for example, picking the baby up—tactile, proprioceptive, and vestibular stimulation. If the mother spoke to the baby as she picked her up, auditory stimulation was added. If the baby and mother made eye contact, visual stimulation was added. This method, when used by Greenberg, had an interrater reliability of .91. Second, a stopwatch was used during multiple viewings to record amounts of stimulation on tabulation sheets showing the stimulation types in 1-minute intervals of activity. Test-retest reliability for this analysis was .93.

From these analyses, the average number of sensory systems stimulated per minute was calculated and average durations of the various stimulation types per minute (i.e., seconds per minute) were determined.

Information from the parent-infant activity record was combined with information derived from videotaped activity sequences to derive estimates of total amounts of stimulation the baby might receive in an “average” day as a result of mother-infant activities.

Results

The Daily Round of Activities. At 4 to 6 weeks after the baby’s birth, her daily round of activities typically consisted of relatively long periods of time alone (about six periods each day, each averaging 2 hours). Between the times the infant was alone (sleeping or otherwise quiet), the mother and baby engaged together (occasionally including the father
or brother) in several successive activities. Each activity period occupied a relatively short period of time (about 30 minutes). A "typical" daily round is illustrated in Figure 1 and shows that the baby was changed 13 times, fed 9 times, and taken out of the home once in the 24-hour period. She had a "fussy period" from 8:00 to 9:30 pm, during which she was fed, changed, held, and consoled.

Table 1 illustrates the frequency and duration of the various activities for the mother and baby during the 3 days the mother recorded their activities. Changing diapers or clothes was the activity that occurred most frequently, followed by feeding, baby alone, hold or carry, etc.

By comparison, "baby alone" was the activity of longest duration, followed by feeding, other, and consoling. Feeding was both a frequent and time-consuming activity for this mother-infant pair. From both mother report and observational visits in the home, feeding usually was intimately associated with play and with holding and carrying; this cluster of activities was reported to be pleasant for them. These activities provided by far the largest amount of stimulation for the baby in a "typical" day.

During activities, the mother was observed as being very attentive to the baby. Overall, their interactions could be described as "gentle." The mother always handled the baby gently and smoothly and she frequently rubbed or patted the baby. She often grasped the baby’s hands or feet and moved them around. She spoke to the baby frequently in high-pitched tones, but in a low, melodious volume. Her speech quality was notably different with the baby than it was with her older child or with adults. She made fre-

<table>
<thead>
<tr>
<th>Activity</th>
<th>Day 1 Freq./ Day</th>
<th>Hrs./Day</th>
<th>Day 2 Freq./ Day</th>
<th>Hrs./Day</th>
<th>Day 3 Freq./ Day</th>
<th>Hrs./Day</th>
<th>Average Freq./ Day</th>
<th>Hrs./Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baby Alone</td>
<td>6</td>
<td>13.75</td>
<td>5</td>
<td>12.50</td>
<td>8</td>
<td>15.75</td>
<td>6.3</td>
<td>14.00</td>
</tr>
<tr>
<td>Feed</td>
<td>9</td>
<td>5.75</td>
<td>8</td>
<td>3.00</td>
<td>9</td>
<td>4.75</td>
<td>8.5</td>
<td>4.50</td>
</tr>
<tr>
<td>Other *</td>
<td>2</td>
<td>1.75</td>
<td>1</td>
<td>2.75</td>
<td>1</td>
<td>1.00</td>
<td>1.3</td>
<td>1.83</td>
</tr>
<tr>
<td>Console</td>
<td>1</td>
<td>0.25</td>
<td>2</td>
<td>2.00</td>
<td>2</td>
<td>0.75</td>
<td>1.7</td>
<td>1.00</td>
</tr>
<tr>
<td>Take Baby</td>
<td>0</td>
<td>0.00</td>
<td>2</td>
<td>2.25</td>
<td>1</td>
<td>0.50</td>
<td>1.0</td>
<td>0.92</td>
</tr>
<tr>
<td>Play</td>
<td>2</td>
<td>0.50</td>
<td>2</td>
<td>1.25</td>
<td>2</td>
<td>0.75</td>
<td>2.0</td>
<td>0.83</td>
</tr>
<tr>
<td>Hold/Carry</td>
<td>4</td>
<td>1.50</td>
<td>3</td>
<td>0.75</td>
<td>1</td>
<td>0.25</td>
<td>2.7</td>
<td>0.83</td>
</tr>
<tr>
<td>Change</td>
<td>10</td>
<td>0.33</td>
<td>8</td>
<td>0.25</td>
<td>13</td>
<td>0.50</td>
<td>10.3</td>
<td>0.36</td>
</tr>
<tr>
<td>Wash/Bathe</td>
<td>1</td>
<td>0.25</td>
<td>1</td>
<td>0.25</td>
<td>2</td>
<td>0.50</td>
<td>1.3</td>
<td>0.33</td>
</tr>
<tr>
<td>Passive</td>
<td>Participation †</td>
<td>1</td>
<td>0.25</td>
<td>1</td>
<td>0.25</td>
<td>0</td>
<td>0.00</td>
<td>0.7</td>
</tr>
</tbody>
</table>

* Other consisted of a variety of activities such as being rocked in a carriage or sleeping in her parents’ bed.
† Baby awake in presence of mother but not the primary focus of her attention.

Table 2
Amount of Stimulation (minutes per day) the Infant Received to Each Sensory System during Mother-Infant Activities

<table>
<thead>
<tr>
<th>Sensory System</th>
<th>Play</th>
<th>Change</th>
<th>Feed</th>
<th>Hold/Carry</th>
<th>Bathe</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vestibular</td>
<td>2.9</td>
<td>1.6</td>
<td>40.5</td>
<td>17.9</td>
<td>1.7</td>
<td>64.6</td>
</tr>
<tr>
<td>Proprioceptive</td>
<td>18.8</td>
<td>9.4</td>
<td>62.1</td>
<td>22.9</td>
<td>14.2</td>
<td>127.4</td>
</tr>
<tr>
<td>Tactile</td>
<td>48.1</td>
<td>15.4</td>
<td>270.0</td>
<td>49.8</td>
<td>20.0</td>
<td>403.3</td>
</tr>
<tr>
<td>Auditory</td>
<td>25.7</td>
<td>9.2</td>
<td>36.0</td>
<td>6.1</td>
<td>8.2</td>
<td>85.2</td>
</tr>
<tr>
<td>Visual</td>
<td>34.0</td>
<td>8.3</td>
<td>8.1</td>
<td>14.6</td>
<td>0.0*</td>
<td>65.0</td>
</tr>
<tr>
<td>Total</td>
<td>129.5</td>
<td>43.9</td>
<td>416.7</td>
<td>111.3</td>
<td>44.1</td>
<td>745.5</td>
</tr>
</tbody>
</table>

* Baby cried with eyes closed during bathing.

Table 3
Average Duration (seconds) of Stimulation That Seemed to Occur Per Minute of Activity

<table>
<thead>
<tr>
<th>Sensory System</th>
<th>Play</th>
<th>Change</th>
<th>Feed</th>
<th>Hold/Carry</th>
<th>Bathe</th>
<th>Baby Alone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vestibular</td>
<td>3.5</td>
<td>4.5</td>
<td>8.9</td>
<td>21.6</td>
<td>5.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Proprioceptive</td>
<td>22.6</td>
<td>26.2</td>
<td>13.8</td>
<td>27.6</td>
<td>43.0</td>
<td>17.7</td>
</tr>
<tr>
<td>Tactile</td>
<td>57.9</td>
<td>42.8</td>
<td>60.0</td>
<td>60.0</td>
<td>60.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Auditory</td>
<td>30.9</td>
<td>25.5</td>
<td>8.0</td>
<td>7.3</td>
<td>24.8</td>
<td>7.2</td>
</tr>
<tr>
<td>Visual</td>
<td>41.0</td>
<td>12.0</td>
<td>1.8</td>
<td>17.6</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>155.9</td>
<td>111.0</td>
<td>92.5</td>
<td>134.1</td>
<td>132.8</td>
<td>44.9</td>
</tr>
</tbody>
</table>
quent eye contact with the baby throughout their activities.

Activities as Providers of Sensory Stimulation. Videotaped mother-infant activities yielded several perspectives on the activities as providers of sensory stimulation. All activities were observed to provide a variety of stimulation, but types and amounts of stimulation varied from activity to activity. Play and changing provided the highest average number of sensory systems stimulated per minute of activity (4.3 out of 5), followed by bathing (3.7), holding or carrying (3.4), feeding (3.3), and baby alone (2.7).

Table 2 shows for each mother-infant activity the total amount of stimulation (in minutes per “average” day) each of the baby’s sensory systems received. Here, of the mother-infant activities, feeding is seen to provide the greatest amount of stimulation, followed by play, holding or carrying, bathing, and changing. Feeding provided the most stimulation per day because it was the mother-infant activity engaged in for the greatest number of minutes each day.

Table 3 provides a comparison of activities on the basis of seconds of stimulation per minute of activity (one way of looking for concentration of stimulation in an activity). Play is seen to provide more stimulation per minute than any other activity, followed by holding or carrying, bathing, feeding, and baby alone. “Baby alone” provided markedly less stimulation per minute than any other activity.

In this study, activities were also compared as suppliers of the specific types of stimulation. Reference to Table 3 demonstrates that, for this mother-infant pair, holding or carrying provided much more vestibular stimulation per minute than any other activity. Bathing was observed to supply more proprioceptive stimulation per minute of activity than any other, whereas play emerged as the activity that provided the greatest amount of both auditory and visual stimulation per minute. Although all activities ranked high as providers of tactile stimulation, feeding, holding or carrying, and bathing provided the most.

Total amounts of the five types of stimulation per “average” day were calculated and are shown in Figure 2. For this infant, the daily round of activities resulted in more tactile stimulation than any other type. Proprioceptive stimulation ranked second, followed by auditory, visual, and vestibular stimulation.

Discussion
As a result of everyday activities, this baby seemed to receive considerable tactile stimulation, but markedly less of all other types and relatively little visual and vestibular stimulation. Play was an important provider of all types of stimulation, and the naturally occurring combination of feeding, playing, and holding or carrying provided by far the most stimulation for this infant. Although further research is needed in order to compare the types and amounts of stimulation this baby experienced in activities to those that other, similar infants experienced, both maternal and infant factors were discovered to have been influential in this situation.

Two categories of influences seemed to act most powerfully—the infant’s characteristics and behavior, and the mother’s perceptions of and beliefs about the baby. These factors were seen to interact with one another. For example: the moth-
er described her infant as a quiet baby who slept a lot, such an easy baby. She said that she did not awaken her to feed or otherwise tend to her, but allowed the baby's natural, sleep-wake patterns to dictate their daily round of activities (maternal belief determining her behavior toward the child). The mother also noted that the baby had been born before the expected due date and was relatively small at birth. Her view of the baby was that she was a tiny little girl, sweet and gentle, and seemed fragile to her (infant characteristics). She therefore handled her gently in all activities (maternal perception of infant determining her behavior). This manner in which the mother performed activities with the baby influenced the types and amounts of stimulation the baby received as a result of their activities. The mother remarked that the baby responded very positively to holding, stroking, and patting by cuddling, by being relaxed, and by not crying (infant behavior). The mother said these reactions from the baby caused her to prolong holding the baby and encouraged her to stroke and pat the baby (maternal perception → maternal behavior).

The mother compared this infant's characteristics and responses to stimulation with those of her 3½-year-old son during his infancy. She reported that he had been a colicky, tense infant who was awake many hours each day crying. She described him as very difficult to soothe, an infant who responded to holding by becoming stiff and crying. Therefore, she had spent many hours rocking him in a buggy or swaying him back and forth as he was held prone across her knees.

In summary, this mother's behaviors in supplying stimulation for both her infants seemed to be influenced by their behaviors, by her perceptions of them, by beliefs she held about them, and by her sensitivity and desire to respond to their signals. Based on these factors, the stimulation that they received was probably very different, the boy receiving a good deal of vestibular stimulation, the girl receiving more tactile stimulation.

Practical Implications. When young infants are ill, or handicapped, hospitalized, and separated from their parents, the parents are deprived of the opportunity of getting to know their babies. The parents are apt to develop exaggerated views of the babies' fragility (22). Atypical infants, such as those treated by occupational therapists in neonatal intensive care units and hospital nurseries also may respond to stimulation in ways the parents view as unusual (for example, stiffness, floppiness, lack of visual responsiveness, excess startle to sounds). The parents may feel uncomfortable or rejected by their babies.

As seen in this study, characteristics of both the infant and mother (especially beliefs of the mother about the baby and her perceptions of the baby) were important in determining the manner in which the mother performed her everyday activities, and thus in the stimulation the baby received in their course. As a result, it seems important in therapeutic programs to work with both mothers and infants.

A major role for the therapist may be to assist parents in becoming acquainted with the characteristics of their babies, especially when the characteristics are unfamiliar or unusual to the parents. The therapist may help the parents in recognizing and responding to their babies' signals, and in learning about their responses to various sensory stimuli. Parents may also need assistance in understanding that each child is an individual who will respond best to stimulation that suits his or her characteristics.

A variety of activities that provide specific types of stimulation may be practiced by the mothers and infants while the mothers learn what their children's responses to the activities are. Mothers may be guided in experimenting with different ways of performing any one activity to discover how different types of stimulation result and to find which ways are most satisfying for them and their babies.

Therapists may also help parents overcome their uncertainty in handling and attending to their babies and reassure them that babies not only tolerate but benefit from sights and sounds, touching, and moving about. In the course of their intervention, therapists must treat parents with consideration and tact, encouraging their interest, knowledge, and desire to care for their babies, not suggesting that they are inadequate caretakers who must rely on "experts."

This therapeutic role in promoting communication and understanding between parents and infants may be important to the long-term growth and development of the infants by encouraging the parents to provide appropriate stimulation for the benefit of their babies' development and by helping parents learn how they are most effective in meeting their children's needs. Parents' feelings of effectiveness are believed to be important in the establishment of a beneficial parent-infant relationship (26). As Schaffer (7) has observed, early experiences between parents and infants can strongly influence the establishment of their long-term relationship, which is important throughout the child's developmental years. Thus therapists'
early interventions may help to prevent or ameliorate problems in the child’s development for years to come.

Summary
The pattern of sensory stimulation experienced by an infant as a result of everyday activities with her mother was characterized as consisting of a variety of types of stimulation, with relatively long periods of low levels of stimulation (when baby was alone), interspersed with relatively short periods of much higher levels of stimulation (during which the mother and baby were engaged together in activities). The majority of the stimulation took place during the naturally occurring activity combination of feeding, holding, and playing. Activities provided more tactile stimulation than any other type, whereas vestibular stimulation occurred least. The manner in which the mother handled the child throughout their activities was found to be an important influence on the types and amounts of stimulation the child received.

The pattern of activities seemed to be influenced by an interaction between characteristics of both the mother and the infant—the baby’s behavior, her response to various kinds of stimulation, as well as the mother’s perceptions of the child and beliefs she held about her.

A comparison of the stimulation parameters of this mother-infant pair with those of other similar mother-infant pairs is needed. In this way, normal ranges of stimulation associated with various activities can be determined and influential factors can be further investigated.

Implications for clinical practice derived from this study include the importance of therapists working with both mother and infant in therapeutic infant programs. Parents may be assisted in overcoming fears about the fragility of their ill infant, may learn the characteristics of their babies, may become acquainted with their responses to sensory stimulation, may learn to respond accordingly and may discover that their babies’ growth and development will benefit from a variety of mild to moderate intermittent stimulation.

Note: Readers interested in applying this research method to other mother-infant pairs may write to the author for a more detailed description of the methods of data collection and analysis.

REFERENCES