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# Orientation of Attention and Sensory Gating: An Evoked Potential and Reaction Time Study in Cat

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Somesthetic-evoked potentials (SEPs) were recorded in eight cats trained to perform a reaction time task (RT). The preparatory period (PP) preceding the RT began with the cat placing its paw in a box and ended 1.5 s later with a paw-withdrawal signal, an imperative stimulus (IS). In experiment 1 (E1), the IS took the form of a vibration in the box, whereas in experiment 2 (E2) a tone was used. The SEPs were elicited by electrical stimulation delivered to the paw once per trial and at a different moment during the last second of each PP. The SEPs were recorded in the lemniscus medialis (LM), the centrum medianum (CM), and over the anterior suprasylvian gyrus (ASSG). During the PP of E1 (four cats), SEPs recorded in the CM and over the ASSG were found to be significantly depressed. No significant change was noted, however, in those recorded in the LM. No significant SEP depression was found in any of the structures in E2 (four cats). Comparison between the two experiments revealed notable differences at both the thalamic and cortical levels. Moreover, SEP depression diminished as the moment for the IS approached. While, in E1, this occurred in the CM and over the ASSG, in E2 it was found in the CM only. Lemniscal and thalamic SEP amplitude was found to be correlated with performance. These findings are discussed in terms of orientation of attention, discrimination, and sensory gating. © 1988 Academic Press, Inc.

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Abbreviations: ASSGe, ASSGl—early, late component of the anterior suprasylvian gyrus; CM—centrum medianum; IS—imperative stimulus, LM—lemniscus medialis; NS—nonsignificant; PP—preparatory period; sRT, lRT—shortest, longest reaction time; SEPs—somesthetic-evoked potentials.

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## INTRODUCTION

Does selecting the information required to carry out a task or improve a performance always result in the gating of nonrelevant sensory input? Although this question has been the object of a great deal of research during the past 30 years, no conclusive solution has yet been found. In the human subject, the evidence presented by both Desmedt *et al.* (4) and Desmedt and Robertson (5) lends weight to the opinion that attentive behavior does not systematically influence early components of cortical-evoked potentials. Somesthetic-evoked potentials were elicited by electrical stimulation delivered in a random sequence to two fingers on each hand. The N20 and P45 waves of these potentials were found to remain unchanged as the subject silently counted the number of shocks being delivered to the target finger or even as detection became increasingly difficult. Velasco *et al.* (29) note that waves recorded on the somesthetic cortex (P50) and in the lemniscus medialis (N20 or P20) do not change during the different tests performed by the subject. These results, combined with those of Picton and Hillyard (21), do not, however, seem sufficient to refute the hypothesis of early differential control over afferent information during a task requiring attention. Recent research shows just how relevant this question still is. For instance, Eason *et al.* (3) and Eason (2) note that the amplitude of the b wave and of the afterpotential of the retinogram can be affected by the orientation of the subject's attention. Mangun *et al.* (16), however, question whether this effect can be replicated. Josiassen *et al.* (12), using the same experimental protocol as Desmedt *et al.* (4), note, contrary to the latter's findings, an average increase in the P45 wave amplitude once the target stimulus has been detected. Lukas (14) shows how the early waves I and V of auditory-evoked potentials, elicited by a 8000-Hz tone are inhibited when the subject carries out a visual discrimination task. The findings of Anthony and Graham (1) and Hackley and Graham (7) also support the theory that sensory input may be selectively controlled even at a subcortical level: they do, indeed, indicate that the blink reflex in man is modulated by conditions of attention.

Although, in the case of the animal, research done by Hernandez-Péon (9) met with strong criticism at the time, different papers now back the theory of attention gating of nonrelevant information. In the cat, Oatman (19) used clicks to elicit evoked potentials within the auditory nerve, the cochlear nucleus, and on the cerebral cortex. He noted a reduction in evoked response amplitude when the animal was engaged in a visual discrimination task. In another paper, Oatman and Anderson (20) showed that during this same task, evoked potentials elicited by auditory stimulation with frequencies ranging from 200 Hz to 10 kHz, could become attenuated at bulbar and cortical levels. Moreover, in a study on the monkey, Hayes *et al.* (8), recording unit activity in thermosensitive neurones from the caudal trigeminal nucleus, reported that the neuronal response became enhanced when a thermal stimulus, deemed essential to the completion of the task, was delivered to the animal.

This paper's main objective is to study the influence on cutaneous input of attention being focused on different sensory modalities. To achieve this, somesthetic-evoked potentials (SEPs) were elicited in cats by nonrelevant stimulation during a preparatory period (PP), which ended with a signal in the same somesthetic modality (Experiment 1). Modulations in these SEPs were then compared with those observed when, at the end of the PP, the animal responded to an auditory stimulus (Experiment 2). More precisely, we first questioned (i) whether SEPs elicited during the PP were different in amplitude from those recorded during a control situation; (ii) whether SEP amplitude varied along the PP; and (iii) whether there was a correlation between SEP amplitude and performance, as measured by the animal's reaction time (RT) to the imperative stimulus (IS). By comparing Experiment 1 with Experiment 2, we then examined the extent to which these effects were due to the modality of the IS itself. Part of the present data has already been used for specific analysis (15).

## METHODS

In this study, the animal was considered "attentive" if, in any given trial, the following two conditions were met: the animal had to (i) remain still at all times during the preparatory period and (ii) respond to the IS with a flexion movement and within a strict time limit. A cat in a sitting position, immobile, and uninvolved in the RT task was, however, considered "inattentive."

*Conditioning.* Eight adult male cats weighing 3.2–4.9 kg were used for this experiment. They were restricted to a dry-food diet. Milk or water, depending on the animal, was given as reinforcement in the experimental cage only. They were trained to perform the following two tasks. For the first 15 min of each session, the isolated animal had to remain alert sitting still in a compartment of the conditioning cage in front of the experimenter. This was defined as the control situation. It was followed by the experimental situation. Each trial began with the animal placing its left forepaw inside a box, the bottom of which was at the level of the cage floor. The paw movement was detected by a photo-cell inserted in the sides of the box. The animal had to keep the paw still and in position for 1.5 s.

In Experiment 1 (E1), four cats were trained to respond, at the end of the preparatory period (PP), to vibration (30 Hz; peak-to-peak displacement, 0.1 mm) of the floor of the box. For the four animals involved in Experiment 2 (E2), however, the PP ended with an auditory stimulus (2000 Hz, 82 dB A) from a buzzer placed above the box at the level of the cat's left ear. The cat responded to the IS with a ballistic paw-withdrawal movement, cutting off the photo-cell and thus terminating the IS. Therefore, the animal's reaction time (RT) was equal to the IS duration. If, in Experiment 1, RT was between 130 and 600 ms, the cat was given liquid in a cup placed in front of him. In Experiment 2, the upper limit for reinforced RTs was set at 500 ms. The animals worked for 30 min. When, on 2 consecutive days, the conditioning criterion of 80% responses to the RT tests within set limits was met, the animals were operated on.

*Electrodes Placement.* The animals were anesthetized with chloralose (50–60 mg/kg). Bipolar concentric electrodes 0.6 mm in outer diameter with tip separation of 1.5 mm were implanted under stereotaxic and electrophysiological controls in both the right lemniscus medialis (LM) and the right centrum medianum (CM). Bipolar recordings of cortical potentials were obtained from two silver-ball electrodes placed on the anterior suprasylvian gyrus (ASSG) contralateral to the paw used for the movement. The animals were grounded through a screw-type electrode implanted in the frontal bone. All electrode placements were checked histologically on serial sections of the brain. At the conclusion of the experiments, animals were sacrificed and the head was perfused with formol–saline. The tips of the electrodes were localized in frozen frontal sections 80 $\mu$m thick.

*Recording Procedures.* Once they again reached the conditioning criterion, the operated animals were tested in daily experimental sessions. Electrical stimulation was delivered to the skin on the inside distal part of the left paw. This electrical stimulus, delivered through two silver discs filled with electrode jelly, was a train of 3 rectangular 0.2-ms-duration shocks, each 0.3 ms apart. For each cat, stimulation intensity was chosen to be just below the threshold for production of motor responses in the moving limb and it was kept constant throughout the session.

Thirty control EPs were recorded every day during the first part of the experimental session. At this first stage, stimulation was delivered at varying intervals, of more than 5 s each, to the immobile animal. During the 30 min which followed, the cat had to complete 100 successful trials. If the animal was not immobile during the whole PP, the trial was cancelled by the experimenter. It was also discarded under program control when the RT was not within the set time limits or when the preceding trial had not been reinforced. Only one cutaneous test stimulation was delivered per trial. The period examined in this study stretched over the last two-thirds of the PP. The 10 times chosen were equidistant (550, 650, 750, . . . 1450 ms), equiprobable (10 occurrences), and placed in a pseudo-random order. The 30 control EPs and the 100 test EPs were amplified and recorded on magnetic tape (system bandwidth, 1 to 3000 Hz). A track on the tape was reserved for storing events needed to measure the RTs.

*The Special Session.* After the ordinary experimental sessions, the animals completed a special control session designed to verify whether the IS had become discriminative during the conditioning period or whether the animals had become conditioned to time. During this session, the IS, used for the first 30 trials was temporarily discarded. The animal was given reinforcement if, as the test began, the paw was withdrawn from the box within the time limits previously set (130 to 500 or 600 ms after the moment the IS would normally have been delivered). When the IS was again delivered, the animal resumed the experiment until 100 successful trials had been completed. Only the animals' RTs were recorded throughout this session.

## DATA ANALYSIS

After checking the accuracy of electrode placements and discarding defective recordings due to momentary saturation of the amplifiers, the following remained for data analysis: (i) in Experiment 1, 27 sessions (three cats) for the ASSG, 35 (four cats) for the CM, and 18 (two cats) for the LM; (ii) in Experiment 2, 31 sessions (four cats) for the ASSG, 34 (four cats) for the CM, and 24 (three cats) for the LM.

Seven EPs (the four shortest RTs (sRT) and the three longest RTs (lRT)) were selected for analysis for each time delay and from each session. Twenty eight control EPs were also chosen from each session.

Recorded data were digitized with a rate of 2 kHz (4 kHz for the lemniscus potentials). Peak-to-peak amplitude for individual EPs was measured by computer within a time window, the limits of which were set after inspection of the averaged control potentials (Fig. 1). The amplitude of every EP in each recorded session and in each structure was expressed as a percentage of the 28 control EPs' average amplitude.

## RESULTS

Data analysis was performed according to the following main factors: session, cat, modality of IS, test time, and performance (sRT or lRT). Figure 2 displays the results taking the last three factors into account.

Tables 1 to 3, respectively refer to the three questions raised at the end of the introduction to the present paper. For each experiment, they summarize the analyses carried out using between-sessions variances as error terms. All the effects submitted to analysis are computed as a difference of means or as a regression slope (one degree of freedom). The observed effect is noted $d$ and the true effect is noted $\delta$. Analysis of variance (program VAR3 (27)) was extended by standard Bayesian inferences (program PIF (22)). Whereas $F$ ratio is only a test of the null hypothesis $\delta = 0$, standard Bayesian inferences enabled us to investigate the magnitude of $\delta$ (26, 13). To a significant result, a statement of this kind is added: $P(\delta < X) = 0.95$ or $P(\delta > X) = 0.95$, indicating which value ($X$) from the $\delta$ parameter has a 0.95 probability of being exceeded. In the case of a nonsignificant (NS) effect a statement of the follow-

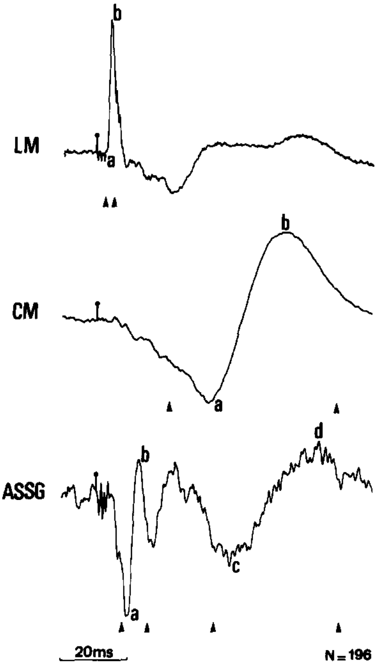

FIG. 1. Average SEPs recorded in the control situation (one cat). Each trace represents the average of 196 SEPs recorded during seven experimental sessions over the anterior suprasylvian gyrus (ASSG), in the centrum medianum (CM), and in the lemniscus medialis (LM). The amplitude of individual SEPs was measured by computer within the time windows indicated by the intervals between the arrows and was characterized by the difference between points a and b for LM, CM, and ASSG (early component), and between points c and d for ASSG (late component).

ing kind is calculated: $P(|\delta| < X) = 0.95$, giving the interval centered on 0 and containing with a probability of 0.95 the true effect: if the value of $X$ is small, the effect must, within reason, be considered negligible, otherwise, experimental precision is insufficient and no conclusion can be extended.

Bayesian distribution on $\delta$ is a Student $t$ test distribution, with the same degree of freedom number as the $F$ ratio denominator, centered on $d$, and with a scale index $e$ denoting experimental imprecision.

In order to examine to what extent the described effects were influenced by the modality of the IS, combinations of Bayesian statements were used (Fig. 3).

*Changes in SEP Amplitude between PP and Control Situation.* On average, during the PP with a vibratory signal (Table 1, E1), early components of the cortical SEP (ASSGe) were reduced ($d = -21.8\%$) as were the late components (ASSGl) ($d = -17.4\%$). Likewise, SEP amplitude recorded in

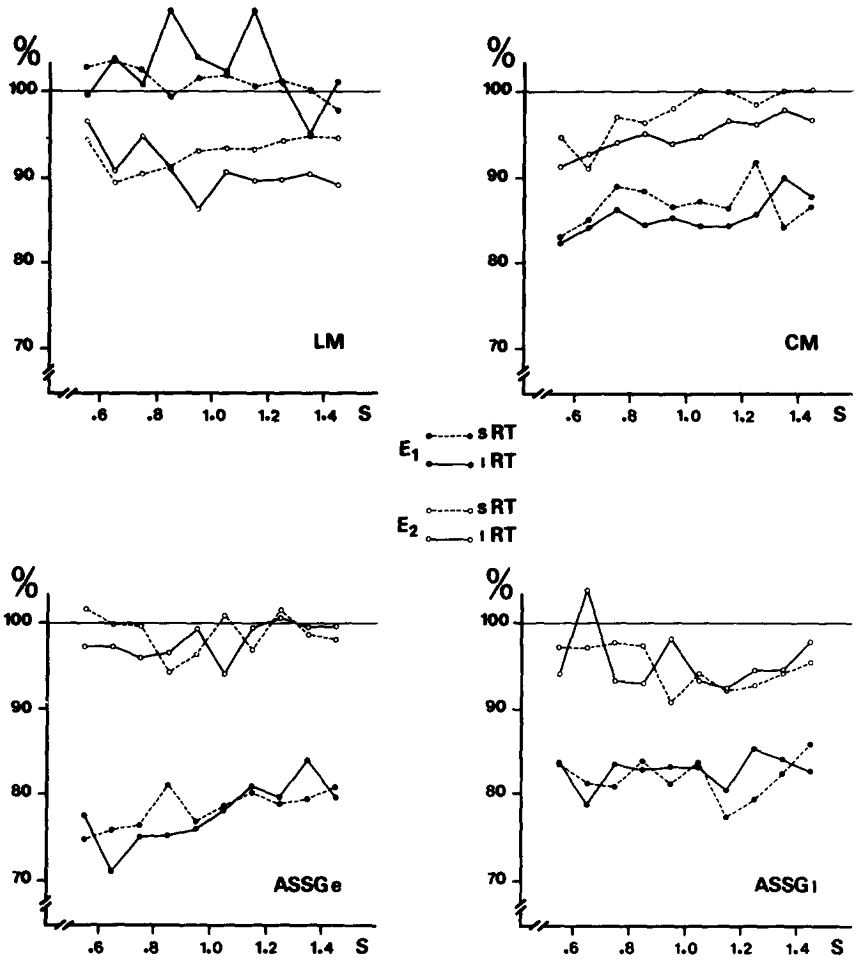

FIG. 2. Time-course of the SEPs amplitude over the PP as a function of performance and IS modality. Amplitudes are expressed as a percent of control potentials. LM—lemniscus medialis; CM—centrum medianum; ASSGe, ASSGl—early, late components of anterior suprasylvian gyrus; sRT, lRT—Short, long reaction time; E1, E2—Experiment 1 (vibration), Experiment 2 (tone).

the CM diminished ($d = -13.4\%$). With Bayesian procedures it was possible to demonstrate, with a guarantee of 0.95, that reduction reaches at least $-8.6\%$ in the CM, $-17.3\%$ for ASSGe, and $-13.0\%$ for ASSGl. The alteration of responses recorded in the LM was not significant ($d = +1.7\%$) and we can thus specify, with a guarantee of 0.95, that the absolute value of the difference $\delta$ was less than 8.3%.

TABLE 1

Changes in SEP Amplitude between PP and Control Situation

| | *F*(df) | *d* | *e* | Bayesian statements |
|---|---|---|---|---|
| E1: Vibration | | | | |
| LM | <1(1,16) | +1.68 | 3.577 | $P(\|\delta\| < 8.28) = 0.95$ |
| CM | 22.45(1,31) | −13.37 | 2.823 | $P(\delta < -8.59) = 0.95$ |
| ASSGe | 69.42(1,24) | −21.76 | 2.612 | $P(\delta < -17.29) = 0.95$ |
| ASSGl | 46.42(1,24) | −17.41 | 2.555 | $P(\delta < -13.04) = 0.95$ |
| E2: Tone | | | | |
| LM | 3.77(1,21) | −7.69 | 3.962 | $P(\|\delta\| < 14.51) = 0.95$ |
| CM | 3.52(1,30) | −3.06 | 1.630 | $P(\|\delta\| < 5.82) = 0.95$ |
| ASSGe | <1(1,27) | −1.66 | 1.708 | $P(\|\delta\| < 4.58) = 0.95$ |
| ASSGl | 3.93(1,27) | −4.78 | 2.411 | $P(\|\delta\| < 8.89) = 0.95$ |

*Note. F*—Snedecor's *F* test, df—Total number of sessions minus number of cats (second number), *d*—Observed differences expressed as percentage of control SEPs, *e*—Scale index of Bayesian *d* ($e^2 = d^2/F$) distribution, δ—True differences expressed as percentage of control SEPs.

When the animal responded to an auditory signal (Table 1, E2), average SEP reduction was not significant. The absolute value of the δ difference was, in this case, less than 14.5% for LM, 5.8% for CM, 4.6% for ASSGe, and 8.9% for ASSGl.

Depression levels, found in E1 and in E2, differed significantly in the CM. Moreover, it was possible to conclude with a guarantee of 0.95 that depres-

TABLE 2

SEP Amplitude Changes over the PP

| | *F*(df) | *d* | *e* | *D* | Bayesian statements |
|---|---|---|---|---|---|
| E1: Vibration | | | | | |
| LM | 4.17(1,16) | +0.32 | 0.158 | 2.90 | $P(\|\delta\| < 0.60) = 0.95$ |
| CM | 5.83(1,31) | +0.54 | 0.224 | 4.86 | $P(\delta > 0.16) = 0.95$ |
| ASSGe | 15.93(1,24) | +0.71 | 0.177 | 6.36 | $P(\delta > 0.40) = 0.95$ |
| ASSGl | <1(1,24) | +0.10 | 0.183 | 0.86 | $P(\|\delta\| < 0.42) = 0.95$ |
| E2: Tone | | | | | |
| LM | <1(1,21) | +0.01 | 0.145 | 0.06 | $P(\|\delta\| < 0.30) = 0.95$ |
| CM | 18.20(1,30) | +0.65 | 0.151 | 5.80 | $P(\delta > 0.39) = 0.95$ |
| ASSGe | <1(1,27) | +0.09 | 0.221 | 0.83 | $P(\|\delta\| < 0.49) = 0.95$ |
| ASSGl | 2.92(1,27) | +0.33 | 0.194 | 2.99 | $P(\|\delta\| < 0.66) = 0.95$ |

*Note. d*—Observed slope as percentage, for every 100 ms, *D*—Total observed effect over the test period, δ—True slope as percentage, for every 100 ms.

TABLE 3

Performance and SEP Amplitude

| | $F$(df) | $d$ | $e$ | Bayesian statements |
|---|---|---|---|---|
| E1: Vibration | | | | |
| LM | <1(1,16) | 1.15 | 1.291 | $P(\lvert\delta\rvert < 3.42) = 0.95$ |
| CM | 1.60(1,31) | 1.31 | 1.038 | $P(\lvert\delta\rvert < 3.07) = 0.95$ |
| ASSGe | <1(1,24) | 0.52 | 0.849 | $P(\lvert\delta\rvert < 2.01) = 0.95$ |
| ASSGl | <1(1,24) | 0.78 | 0.798 | $P(\lvert\delta\rvert < 2.15) = 0.95$ |
| E2: Tone | | | | |
| LM | 5.77(1,21) | 1.86 | 0.777 | $P(\delta > 0.53) = 0.95$ |
| CM | 9.90(1,30) | 3.23 | 1.028 | $P(\delta > 1.48) = 0.95$ |
| ASSGe | <1(1,27) | 0.88 | 1.331 | $P(\lvert\delta\rvert < 3.18) = 0.95$ |
| ASSGl | <1(1,27) | 0.54 | 1.220 | $P(\lvert\delta\rvert < 2.71) = 0.95$ |

*Note. d*—Amplitude difference between SEPs followed by short RT or by long RT.

sion in this structure was at least −8.6% when the animals were preparing to respond to the vibratory signal and at most −5.8% when they had to detect an auditory signal. This result may be stated in the following manner: $P(\delta/\text{E1} < -8.6 \text{ and } \delta/\text{E2} > -5.8) = 0.95^2$. Similarly, the difference between depression levels, in E1 and E2, was significant for ASSGe, $P(\delta/\text{E1} < -17.3 \text{ and } \delta/\text{E2} > -4.6) = 0.95^2$, and in the case of ASSGl, $P(\delta/\text{E1} < -13.0 \text{ and } \delta/\text{E2} > -8.9) = 0.95^2$.

*Time-Course of SEP Amplitude Changes over the PP.* Whenever SEP depression was present in any significant manner, it diminished just prior to

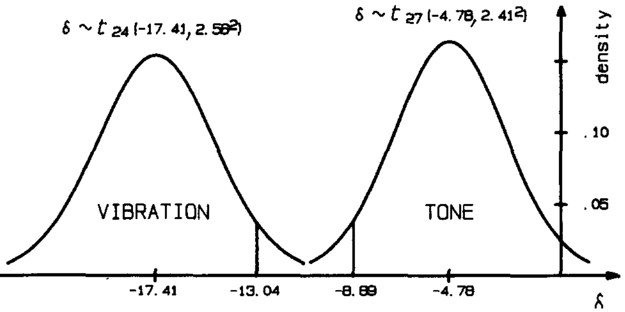

FIG. 3. Examples of Bayesian statements. Preparatory period vs control situation: the case of the ASSGl for each IS modality. If we consider $\delta$ to be the parent difference between the amplitude of the test SEPs and that of the control SEPs, then from each density graph we learn about the probability of the values of $\delta$ for one IS modality at a time. By considering both distributions together, it is possible to state that, with a probability of $0.95^2$, depression reaches at least −13.0% in vibratory condition and at most −8.9% in auditory condition.

the IS. Thus, when the signal was vibratory (Table 2, E1), the amplitude of the early cortical wave increased by 6.4% over the last second of the PP, and that of the thalamic SEP by 4.9%. When the animal was preparing to respond to the auditory stimulus (Table 2, E2), the increase in SEP amplitude was significant (5.8%) in the CM.

In E1, with a probability of 0.95, the $\delta$ increase over the last 1 s of the PP was 3.6% for ASSGe and 1.5% for CM. (This corresponds to slopes of 0.40% for ASSG and 0.16% for CM for each 100-ms interval of the PP). In E2 the overall increase was greater than 3.5% for CM. The interaction between modality and the linear component of the delay effect was significant for ASSGe only ($F = 6.26(1,51)$; $p < 0.05$).

*Performance and SEP Amplitude.* When the signal was vibratory, the overall mean for the long RTs was 464 ms and that of the short RTs was 307 ms. When the IS was a tone the means were 370 and 248 ms, respectively.

In E2 (Table 3), amplitude of the cortical SEPs did not significantly change with performance. In the LM and CM, SEP amplitude increased as the RTs became shorter: the average increases were 1.9 and 3.2%, respectively. With a 0.95 guarantee, the differences between SEPs followed by long RTs and those followed by short ones were greater than 0.5% in the LM and 1.5% in the CM.

In E1, it was not possible to extend conclusions from any structure with the guarantee of 0.95.

Interaction between modality of IS and performance was not significant in any of the structures tested: $F = 3.72(1,37)$ for the LM, $F = 2.24(1,61)$ for the CM, $F < 1(1,51)$ for the ASSG, and $F < 1(1,51)$ for the ASSGl.

*The Special Session.* When the vibratory signal was withheld in Experiment 1, the percentage of reinforced trials fell from 78.4 to 46.7%. In Experiment 2, withholding the auditory stimulus caused a much greater impairment in performance: the percentage of successful trials dropped from 87.3 to 5.5%. Once the IS was again delivered, the percentage of correct responses rose to 78% in E1 and to 88.1% in E2. It was also noted that, in the half-hour session during which the response signal was held back, the cats in E1 placed their paws in the box 128 times, on average, and those in E2, 45 times. Lastly, the average of the median RTs measured for each cat during the special session was 409 ms for E1 and 2217 ms for E2.

## DISCUSSION

*SEPs and Orientation of Attention.* Thalamic and cortical SEP depressions observed when the PP ended with a vibratory signal, cannot be attributed to either the nature of the response involved or its preparation. Indeed, on the one hand, the animals responded with the same flexion movement whether the withdrawal signal was vibratory or auditory. On the other hand, it was not possible to establish a consistant link between performance (which reflects the level of preparation involved (25)) and SEP amplitude. Admittedly, in Experiment 2, wave amplitude recorded in the lemniscus and in the centrum medianum was found to be more enhanced in the trials ending with a short RT than in those ending with a long RT. However, the same correlation was not present in Experiment 1, in spite of greater differences between short and long RTs (156 ms, as against 122 ms in E2).

Differences between average RTs in Experiments 1 and 2 (76 ms shorter in Experiment 2) do not sufficiently explain reduced SEP depression in E2. The difference between the RTs can, in part, be attributed to the different nerve pathways taken by the tactile and auditory signals. Furthermore, findings show that in spite of modality differences, the block of long RTs in Experiment 2 was longer than that of short RTs in Experiment 1. These short RTs, however, do go with smaller SEP amplitudes (CM, $F = 2.83(1,61)$, $0.05 < P < 10$; ASSGe, $F = 26.17(1,51)$, $P < 0.001$; ASSGl, $F = 14.11(1,51)$, $P < 0.005$).

To refute an interpretation in terms of spatial attention, we were careful to locate both the vibration and the tone in the same left hemispace. This was a useful precaution in view of Hillyard *et al*'s (11) findings in human subjects, which show that "even in the irrelevant modality, there are clear differences between ERPs to stimuli at attended and unattended locations."

The differences between Experiment 1 and 2 should rather, we suggest, be attributed to a specific effect produced by attention being directed toward imperative signals of different modalities.

This specific attention orienting effect is, apparently, coupled with a nonspecific effect in the CM, since SEP depression diminished as the PP ending with a vibratory or auditory signal proceeded. As Näätänen (17, 18) first pointed out this nonspecific SEP amplitude enhancement could be attributed to the regular experimental design. Indeed the PP duration was constant in both E1 and E2 and the increase in SEP amplitude over the whole PP could indicate anticipation of the relevant signal. These findings tie in with the results in the monkey (24) which show that, during a 2-s PP, the activity of certain reticular formation cells gradually increases until it reaches its maximum 100 ms prior to the imperative signal. The activity of these cells could be related to "cue stimuli" and "may be compatible with phasic arousal of reticular structures influencing large regions of the brain via the diffuse efferent connections of the RF" (24).

During the last second of the PP the amplitude of the early component of cortical SEPs increases, only when the IS is a vibration. This suggests a specific control of sensory transmission in the ventral posterior thalamus, as this component is supposed to reflect activity of this thalamic region (23).

*Stimulus Discrimination and Sensory Gating.* Our positive reinforcing procedure produced and maintained attentive behavior in the cats. Disruption in the regular test structure immediately disturbed this behavior pattern. The IS, then, played a major role in the completion of RTs within the limits set. Whether the signal was vibratory or auditory, its power to elicit the flexion response grew as the procedure was carried out; it became relevant.

This being so, why, then, are the SEPs, elicited during the PP by electrical stimulation to the skin, more depressed in the animals awaiting the vibratory stimulus than in those awaiting the auditory one? Cutaneous stimulation delivered to the animals of E1 during the PP was of the same modality as the IS ending this PP. It was also delivered to a cutaneous site adjacent to the pad receiving the IS. The animals in E1 had to carry out a twofold task: intramodal discrimination on the one hand and spatial discrimination between two very close cutaneous sites on the other. By comparison, the animals in E2 were assigned a simpler task of intermodal discrimination alone. The depression of thalamic and cortical SEP, observed in Experiment 1, could be a sign of the difficulty involved in discrimination. Similarly this difficulty helps to account for the behavioral differences noted during the special sessions organized under both experimental conditions. Electrical cutaneous stimulation in E1, being, from a modalitary and spatial point of view, very close to the vibratory imperative signal, could then automatically result in a better performance from the cats. Our findings compare favorably with those of Josiassen *et al.* (12) who state that when a subject counts the number of stimulations being delivered to the target finger, the N60 wave elicited by electrical stimulation to the adjacent finger diminishes in amplitude. Furthermore, we suggest that they throw new light on the question put by Hillyard (10): "when one attends to a given locus on a sensory dimension is attention more a facilitation of information coming from that locus or more a suppression of inputs from adjacent loci? or do both mechanisms operate?"

When test and imperative stimuli have almost the same characteristics, then reduction of the SEPs amplitude could point to an inhibition mechanism acting at thalamus level and dependent on more rostral structures, such as the prefrontal cortex which is supposed to be involved in suppressing sensory interference (6). A nonexclusive explanation can be found within the framework of the gating system put forward by Skinner and Yingling (28). These authors, do, in fact, see the mediothalamic-frontocortical system as playing a major role in the animals' ability to inhibit their behavioral responses to nonrelevant stimuli; they show that by coming into play, this system selectively activates the nucleus reticularis thalami which, in turn, inhibits its nonrelevant thalamic input.

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