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Choice Between Melodies Differing in Complexity Under Divided-Attention Conditions

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The processing-capacity and arousal-level effects on choice between computer-generated "melodies" differing in complexity were compared in a divided-attention situation. Subjects were exposed to either aversive (97 dB, 350-Hz square wave) or mild (56 dB) auditory stimulation prior to blocks of trials involving choice between simple (4.00 bits/tone) and complex (9.17 bits/tone) melodies. Concurrently with the processing of the chosen melody on each trial, subjects either had no task at all or worked on one of four tasks that systematically differed in (a) the processing effort demanded, and (b) the likelihood of an arousal-level increase due to conceptual conflict and/or physical exertion. Measures were obtained of changes in choice and cardiac arousal due both to auditory stimulation and tasks. Results showed that the processing-capacity factors influenced choice quite independently of the arousal-level fluctuations due to tasks, and suggested that an arousal-level increase (due to stimulation), even when relevant for choice, may be mediated by a reduction in processing capacity.

Two principal features of Berlyne's (e.g., 1971a, 1974) "new experimental aesthetics" seem to be (a) an attempt to describe objects of aesthetic enjoyment in terms of collative stimulus properties, such as complexity and novelty, and (b) an emphasis on the role of arousal and the arousal potential of collative stimulation in aesthetic preference. The collative-motivation model has been a major theoretical advance and a useful heuristic device. However, it has largely neglected the differential cognitive "labeling" of fluctuations in arousal level as a function of the social and nonsocial context (e.g., Konečni, 1975a, 1975b; Schachter, 1964, 1975; Zillmann, 1971), which has been shown to be relevant for aesthetic preference (Cantor & Zillmann, 1973; Konečni, Crozier, & Doob, in press; Konečni & Sargent-Pollock, in press). In addition, neither the collative-motivation model nor the labeling approach has closely examined the mechanism linking arousal level to preference and choice: How is it that relatively gross changes in the arousal system affect the complex and subtle operations presumably involved in the aesthetic and most other types of choice? It seems that a good case can be made here for the applicability of recent developments in the area of attention, particularly the limited-processing-capacity model (e.g., Broadbent, 1958; Kahneman, 1973; Moray, 1969; Posner, 1975; Treisman, 1964). The present research was primarily concerned with the application of this model in a modified divided-attention paradigm involving choice between melodies differing in complexity.

An important derivative of Berlyne's model (e.g., 1967) is that the choice of stimuli in the higher ranges of collative dimensions (e.g., relatively complex patterns) should decrease when the level of arousal is high. This hypothesis has usually been discussed in conjunction with findings that complex stimuli raise the level of arousal (e.g., Berlyne, Craw, Salapatek, & Lewis, 1963; Bryson & Driver, 1969) and has often

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been linked to the assumption of an "optimal" level of either arousal (Berlyne, 1960; Hebb, 1955) or stimulus complexity (Berlyne, 1971a; Dember & Earl, 1957; Munsinger & Kessen, 1964; Schroder, Driver, & Streufert, 1967). However, evidence has been mounting against both the optimal-arousal (e.g., Berlyne, 1967; Routtenberg, 1971) and the optimal-complexity position (Steck & Machotka, 1975). The latter authors have shown that the preference for complexity is almost entirely determined by the range of stimuli judged.[1]

Nonetheless, the main hypothesis has received fairly solid (Berlyne & Crozier, 1971; Berlyne & Lewis, 1963; Day, 1965; Konečni et al., in press), if not unanimous (Berlyne, 1971b; Day & Thomas, 1967), experimental support. The hypothesis is thus of interest and requires an explanation quite apart from the validity of its (alleged) optimal arousal/optimal complexity corollaries.

We suggest that in many situations, choice (including aesthetic choice) may be guided and constrained by the relative processing demands of the alternatives, rather than by their arousal potential. For example, in the paradigm used by Konečni et al. (in press), subjects were aroused and then chose on each of 50 trials to listen to either simple (4.00 bits/tone) or complex (9.17 bits/tone) computer-generated melodies lasting for 10 sec. The two types of melodies had been demonstrated prior to the beginning of the session—by no means an atypical procedural feature. Thus, subjects were well aware prior to the first trial, and particularly over trials, of the relative processing demands of the two types of melodies. Complex stimuli presumably require more processing effort than do simpler ones, except perhaps in cases of extreme complexity, where the pattern may be perceptually simplified or "supersigns" formed (e.g., Attneave, 1954; Gunzenhäuser, 1962). A subject's choice of a simple or complex melody on a particular trial or groups of trials may therefore reflect a decision to allocate more or less processing capacity to the subsequent stimulation. However, the allocation policy would presumably also depend on other (concurrently made) demands for processing effort, the overall processing load, and the extent of the spare capacity (Kahneman, 1973). In short, we are suggesting that choice involving stimuli of different complexity may in part reflect the amount of processing effort that a subject expends or expects to expend on other tasks during the processing of the chosen pattern (melody).

The main purpose of the present experiment was to show that capacity factors can play a very prominent role in this type of choice. A successful demonstration that the choice of simple/complex melodies may be independent of their arousal potential and determined by purely cognitive factors would be important in its own right. In addition, this would be the essential first step in building support for a related argument: The effect on choice of the level of arousal induced prior to choice may itself be due to changes in processing capacity. Namely, a high level of arousal may reduce the preference for complex stimuli merely because it decreases the overall processing capacity. This may be regarded as an extension of the views that high arousal "narrows" attention and impairs discrimination and cue selection (e.g., Broadbent, 1971; Easterbrook, 1959; Kahneman, 1973; Sokolov, 1963). Perhaps as important is the possibility that the cognitive monitoring of physiological changes requires processing effort. Another possibility is that processing effort is expended on "coping" with the aversive information and its external source, as in situations in which a subject anxiously awaits electric shocks or a memory test, or ruminates about insults he has just received (e.g., Averill & Rosenn, 1972; Berlyne & Lewis, 1963; Houston & Holmes, 1974; Konečni et al., in press; Monat, Averill, & Lazarus, 1972). All of these interpretations suggest that highly aroused people may shun complex stimuli because of processing-capacity considera-

[1] Interestingly enough, one of Steck and Machotka's (1975) interpretations of a subject's "point of preferred complexity" in various stimulus ranges was in terms of optimal arousal, a notion they attributed to Berlyne.

tions; in fact, the coping interpretation treats the arousing consequences of aversive information/stimulation as epiphenomenal. However, all of such interpretations seem to hinge on the demonstration that the processing-capacity factors may directly affect choice.

In the present experiment, subjects were exposed to either aversive or mild auditory stimulation prior to blocks of trials that involved the choice between melodies differing in complexity. Concurrently with the processing of the chosen melody on each trial, subjects either worked on no task at all or worked on one of four tasks that systematically differed in (a) the processing effort demanded, and (b) the likelihood of an arousal-level increase due to "conceptual conflict" (Berlyne, 1960) and/or physical exertion. Independent measures were obtained, over blocks of trials, of changes in choice and cardiac arousal due both to the aversive/mild prechoice stimulation and the various tasks. The experiment was thus a relatively comprehensive attempt to analyze the subtle interplay of cognitive and motivational factors in this type of choice, with reference to issues that have been raised.

Method

Design

The design was a 2 × 5 × 5 factorial. The first (between-subjects) factor was the type of prechoice auditory stimulation (aversive or mild). The second (between-subjects) factor was the type of task in which subjects were engaged during the choice trials. The third (within-subjects) factor represented blocks of 10 trials each. (Note that each of five blocks was actually subdivided into two sub-blocks of 5 trials, and that each sub-block was preceded by auditory stimulation.) The dependent measures were the proportion of complex/simple melody choices and systolic blood pressure.

Subjects

Subjects were 100 female students from the University of California, San Diego. Ten subjects were randomly assigned to each condition of the basic 2 × 5 design.

Auditory Stimulation: Characteristics

Oscillator 403B (Bryston) was used to generate auditory stimuli, 350-Hz square wave. A tape was prepared such that 2, 4, or 8 sec of stimulation were randomly interspersed with 1, 2, or 3 sec of silence, with each 1-min segment containing 42 sec of stimulation and 18 sec of silence. The aversive-stimulation condition consisted of 20 sec of stimulation administered through the earphones at 97 dB (A) prior to each sub-block of 5 choice trials; the mild-stimulation subjects heard 20 sec of stimulation at 56 dB (A) prior to each sub-block.

Auditory Stimulation: Rationale

The stimulation and procedure described above were chosen for several reasons. First, the use of white noise (90 dB) has produced mixed results in terms of the choice of simple/complex stimuli (e.g., Berlyne, 1971b; Day, 1965). Second, to facilitate the interpretation of results, we tried to minimize the likelihood that processing effort would be expended on the previously mentioned cognitive coping with the aversive information itself. The use of the insult procedure was thus ruled out, even though such social stimulation reliably decreased the choice of complex melodies in an earlier experiment (Konečni et al., in press), and generally produces far more pronounced physiological effects than quite drastic nonsocial events, such as the cold-pressor test (Kahn, 1966). In studies with two University of Toronto samples, we searched for a compromise solution and found that: (a) 350-Hz square wave was rated as far more aversive than white noise in the entire loudness range studied (60–90 dB); (b) the 60 versus 90 dB spread of the 350-Hz stimulation had strong differential effects in terms of the rated aversiveness and physiological indices; and (c) with this spread on a between-subjects basis, and with 20 sec of stimulation prior to each block of 10 trials, the effect on the choice of simple/complex melodies over 50 trials was rather weak ($p = .153$), though in the predicted direction (90-dB subjects chose fewer complex melodies).[2] Therefore, in the present experiment, we increased the loudness-level separation (56 vs. 97 dB), doubled the total duration and frequency of exposure to the stimulation, and treated subjects' initial preferences as covariates.

It seems that by using unassimilable stimulation and exposing subjects to it before the choice trials, we minimized the possibility of a coping interpretation. Choice could not be affected by the processing of the stimulation itself, unless a somewhat unlikely "processing fatigue" explanation is invoked. Of course, the notion that the stimulation-produced arousal reduces the processing capacity is not in any way affected by these considerations.

Tasks and Procedure

Subjects were told that the experiment investigated music preferences. After the initial blood-

[2] Details of the pilot experiments can be obtained by writing to the first author.

pressure measurement, two 10-sec sequences of each type of melody were demonstrated (order counterbalanced). Melodies were always played at a comfortable listening level (74 dB). Each subject then had 10 melody-choice trials, where a trial consisted of pressing one of two buttons and hearing in both ears through the earphones either a simple or a complex melody for 10 sec. Subjects knew which button produced which type of melody, and that the melody could not be discontinued during the 10-sec interval. It was stressed that there were no right or wrong responses. Two more blood-pressure readings were obtained during these initial-preference trials, and another at their completion. All subjects then had 50 choice trials divided into 10 sub-blocks of 5 trials each; the number of trials was not announced in advance. Readings of blood pressure were obtained during the first, fourth, seventh, and tenth 20-sec noise interval, and during the first, third, sixth, and eighth sub-block of 5 choice trials.

One fifth of the subjects did not work on any task during the choice trials. Another one fifth worked on the digit–symbol task. This task was used because it requires the continuous processing of information, with little fluctuation in processing difficulty over time. Subjects were given a booklet that could not be completed in the time allotted. Each page in the booklet contained a key relating digits to various symbols, and a large number of digits below which the appropriate symbols had to be written in. Subjects were urged to be fast and accurate. They worked continuously during the choice trials, pausing only to press one of the two buttons every 10 sec. To allow the full impact of stimulation, work was not allowed in this or other conditions during the 20-sec stimulation intervals preceding sub-blocks of trials.

It was predicted that the processing demands of the digit–symbol task would reduce the proportion of complex-melody choices in comparison to the no-task group. However, such an outcome would not unequivocally support the processing-capacity hypothesis, unless the possible arousal-generating effects of the digit–symbol task were controlled for. One possibility was that the muscular activity and physical effort involved in the execution of the digit–symbol task (rapid writing) would raise the level of arousal. To control for this possibility, an additional group was included. These subjects were given the digit–symbol sheets with responses already filled in and asked to trace, as fast as possible, the contour of each filled-in symbol with an IBM pencil ("for subsequent computer analysis"), without checking the correctness of the answers. Thus, they engaged in as much rapid writing as the digit–symbol group, but had to process far less information. The cognitive capacity hypothesis predicted that these subjects' choice behavior would be similar to the no-task group's.

Another possibility was that the digit–symbol task—a series of miniproblems—consisted of repeated instances of conceptual conflict, which is presumably salient at decision points in problem-solving activity and has arousal-raising properties (Berlyne, 1960; Blatt, 1961). It could well be argued that such conflict should be distinguished from the idea of processing effort/load. Therefore, on the assumption that the active storing of information involves much processing effort, but contains fewer elements of conflict than the work on the digit–symbol task does, an additional condition was included. These subjects closely attended to slides of paintings during the choice trials and tried to memorize as many details as possible. A different slide was shown during each of the 10 sub-blocks of 5 trials, and it remained in view during the entire sub-block (50 sec). The projected image was 46 × 66 cm, 152 cm directly in front of the seated subject. Finally, a group of subjects saw the same slides, but without the memorization instructions; they were told that the only purpose of the slides was to "enrich their visual environment."

The level of physical activity in the two conditions involving slides was equal and minimal; also, these conditions presumably contained few elements of conceptual conflict and actually qualified for membership in the class of tasks that, according to Lacey (e.g., Lacey & Lacey, 1974), produces cardiac deceleration. Nevertheless, the processing-capacity hypothesis, unlike an arousal model, would predict that the memorization subjects would choose fewer complex melodies than subjects without such instructions.

Slides of paintings. The 10 paintings used were by Leonardo (4), Michelangelo (3), Raffaello (1), Tintoretto (1), and Guardi (1). For the purpose of a different experiment (Konečni & Sargent-Pollock, in press), the galvanic skin response to these and other paintings from a similar population was obtained, as well as ratings on a number of dimensions. Paintings selected for the present experiment were homogeneous with regard to the mean ratings of pleasingness, interestingness, and desire to own a reproduction, as well as the relatively small skin response they evoked (mean ratios of peak over baseline ranging from 1.05 to 1.14 for different paintings).

Melodies. The two types of melodies between which subjects had to choose were identical to those in the Konečni et al. (in press) study. The method of construction had been originally developed by Vitz (1966). A PDP-8/S computer was used to generate two types of continuous melodies (an average of 2 tones/sec) differing in complexity or uncertainty (Garner, 1962). This was achieved by varying the number of pitches, durations, and loudnesses from which the two types were constructed. A tone could be repeated before other possible tones within a type had been chosen (sampling with replacement). The quantification in information-theory terms consisted of taking the logarithm (base 2) of the total number of possible tones used in the construction of a given type of melody. In the construction of simple melodies, there was a total of 16 possible tone-events (different pitch–duration–loudness combinations), or a complexity/uncertainty level of 4.00 bits/tone; 576 tone-events were possible for complex melodies, or 9.17 bits/tone.[3] As a result of the method of construction, different 10-sec melodies of a given type were similar, but not identical. However, both quantitatively and subjectively, any 10-sec simple melody was far simpler, involving less uncertainty, than any 10-sec complex melody. Loosely speaking, while the former were reminiscent of nursery tunes, the latter resembled avant-garde music. However, earlier work had indicated that normally aroused subjects choose the two types of melodies equally often and listen to them equally long (Crozier, 1974; Konečni et al., in press).

Blood-pressure measurement. The equipment consisted of a soft cuff and an automatic Sphygmo-Recorder (Physiometrics, Inc.). The cuff was on the subject's nonpreferred arm throughout the session. It was the only part of the instrument visible to the subject, and was automatically inflated and deflated for the purpose of measurement from the adjoining control room. A sensitive transducer detected flow disturbances in the artery below the cuff (*not* the resulting Korotkoff sounds). Prior to the session, subjects were told that the cuff would periodically inflate and deflate, and that they should ignore these events. Over the next 5 min, subjects were habituated to inflations and deflations.

Results

Checks on Procedure

To insure that instructions in the two conditions involving slides indeed differentially affected the respective processing load and effort, half of the subjects (randomly selected) in these conditions were again shown, after the choice trials, each of the 10 slides for 5 sec. Following each exposure, subjects were asked questions about the painting. Questions were standardized and somewhat different for each painting. They referred to the number of people or ships portrayed, the presence or absence of halos, church spires, or animals, and the like. The perfect score on this test was 20. The 10 subjects who had received the memorization instructions scored significantly better [$M = 13.00$; two-tailed $t(18) = 2.78$, $p < .02$] than did the 10 subjects who had not received such instructions ($M \doteq 6.60$). Thus, the memorization subjects did store more information and presumably expended more processing effort during the choice trials than the no-memorization subjects.

A question may also be raised whether subjects in the contour-tracing condition took their instructions seriously. If they did, they should have completed far more items than the digit–symbol group, in view of the respective difficulty of the two tasks. This was indeed the case. The digit–symbol subjects completed 249.60 items correctly on the average, which was only 69% of the number of items completed by the contour-tracing subjects, $M = 362.60$; two-tailed $t(38) = 2.99$, $p < .01$. It is thus safe to conclude that the contour-tracing subjects engaged in at least as much physical activity (rapid writing) as did the digit–symbol subjects.

Systolic Blood Pressure

A total of 12 readings of blood pressure was obtained from each subject. Due to negligible differences, the first 4 readings (1 before and 1 after the initial-preference trials, and 2 during these trials) were averaged and treated as a subject's resting-state pressure. Four additional measures were calculated (based on 8 readings): stimulation-early (an average of the readings during the first and fourth 20-sec period of prechoice stimulation), stimulation-late (an average for the seventh and tenth period), choice-early (an average for the first and third sub-block of 5 choice trials), and choice-late (an average for the sixth and eighth sub-block). A difference score was obtained between each of the above four measures and the subject's resting-state

[3] The four simple-melody pitches (note names and cycles per second) were F_4 (349), G_4 (392), A_4 (440) and C_5 (523); durations (2) were 333 and 667 msec; loudness levels (2) were 75 and 80 dB. Complex-melody pitches (18) were F_4, G_4, A_4, B^b_4 (466), C_5, D_5 (587); F_3 (175), A_3 (220), C_4 (262), D_4 (294), F_5 (698), G_5 (784); F_2 (87), C_3 (131), D_3 (147), A_5 (880), C_6 (1,047), F_6 (1,397); durations (8) were 40, 81, 162, 323, 485, 646, 970, and 1,293 msec; loudness levels (4) were 70, 75, 80, and 85 dB. Durations within a type were in prime number ratios, thus producing an underlying rhythmic pulse, or "tempus," known as "quantitative rhythm," and common in twentieth-century musical composition.

measure. These difference scores were submitted to a 2 (aversive stimulation vs. mild stimulation) × 5 (tasks during choice) × 2 (during stimulation vs. during choice) × 2 (early vs. late) analysis of variance. The last two factors were within subjects.

The mean systolic-pressure difference scores are presented in Table 1. The means were all positive, although the blood pressure of a number of subjects was actually lower than at resting state. The main effects of both the type of stimulation and early/late factors were highly significant in the expected direction [$F(1, 90) = 22.41$, $p < .01$, $MS_e = 6.86$, for the type of stimulation factor; $F(1, 90) = 29.61$, $MS_e = 3.31$, for the early/late factor]. The significant interaction of these two factors, $F(1, 90) = 23.40$, $MS_e = 3.31$, indicated that the difference between the effects of aversive and mild stimulation was almost entirely due to readings taken early in the session.

The main effect of type of task was also significant, $F(4, 90) = 2.51$, $p < .05$, $MS_e = 6.86$. Subjects were by far the most aroused by the digit–symbol task; the contrast between the digit–symbol treatment and the other four conditions yielded an $F(1, 90)$ of 7.19, $p < .01$; the residual was not significant, $F(3, 90) < 1$. However, the digit–symbol subjects, who not only engaged in rapid writing, but also presumably experienced conceptual conflict, were not significantly more aroused than subjects in the contour-tracing condition, who merely wrote rapidly, $F(1, 90) = 1.32$. In addition, whereas the latter subjects were somewhat more aroused than the no-task subjects, $F(1, 90) = 2.66$, $p < .11$, there were no differences between the no-task condition and the two treatments involving slides, which also did not differ from each other (all Fs < 1).

In summary (a) aversive stimulation was arousing, but mainly early in the session, (b) conditions involving physical activity (rapid writing) were more arousing than those that involved watching slides or no task at all, (c) the increment in arousal due to conflict and problem-solving activity was very small (the digit–symbol condition vs. the contour-tracing condition), and (d) the treatment involving the storage of information (slides memorization) did not differ from merely watching slides or having no task at all: None of these were arousing.

Choice of Melodies

The choice data, in the form of proportions of complex-melody choices, were transformed into arcsine units and submitted to the 2 × 5 × 5 analyses of variance and covariance. The proportion of complex-melody choices made by subjects in the initial 10 trials served as the covariate. The main effects of both stimulation and type of task were statistically significant and further enhanced when initial preferences were considered [$F(1, 89) = 6.90$, $p = .01$, for the stimulation factor; $F(4, 89) = 2.97$, $p \approx .02$, for type of task; $MS_e = .2252$; the within-cell regression was homogeneous, $F(9, 80) = 1.10$, *ns*]. The effect of blocks and all interaction terms were entirely negligible. The cell means, adjusted for initial preference, were converted back to proportions; Table 2 presents the mean percent of

TABLE 1

MEAN SYSTOLIC BLOOD PRESSURE DIFFERENCE SCORES (IN MM HG) BY EXPERIMENTAL CONDITION

		Task during choice									
		No task		Digit-symbol		Contour tracing		Slides/memorization		Slides/no memorization	
		Type of stimulation									
Measurement during	Time of measurement	Aversive	Mild	Aversive	Mild	Aversive	Mild	Aversive	Mild	Aversive	Mild
Stimulation	Early	3.0	.5	4.3	1.2	3.8	1.0	2.9	.8	3.0	.7
	Late	.9	.2	1.9	.9	1.2	.9	.9	.8	1.0	.6
Choice	Early	2.5	.6	3.7	2.3	3.2	1.6	2.5	.8	2.5	.7
	Late	.9	.5	2.0	2.0	1.5	1.3	1.0	.9	1.4	1.0

TABLE 2

MEAN PERCENT OF COMPLEX-MELODY CHOICES BY EXPERIMENTAL CONDITION

Prechoice stimulation	Task during choice				
	No task	Digit-symbol	Contour tracing	Slides/memorization	Slides/no memorization
Aversive	39.48	20.87	41.80	25.84	43.89
Mild	54.37	35.93	47.55	41.78	51.63

Note. $n = 10$. The means were adjusted for initial preference.

complex-melody choices by experimental condition of the basic 2 × 5 design.

It is evident that the exposure to aversive stimulation sharply reduced subjects' preference for complex melodies. The absence of an interaction ($F < 1$) indicated that this was true irrespective of the type of task in which subjects engaged during the choice trials. Thus, aversive stimulation both increased the level of arousal and decreased the preference for complex melodies, which replicated the results of Konečni et al. (in press). A correlation was also computed between the proportion (in arcsine units) of each subject's complex choices over 50 trials and her mean systolic blood-pressure elevation over base level during these trials. Over 100 subjects (this also holds within each of the 10 conditions), a significant negative correlation was obtained, $r(98) = -.33$, $p < .01$. In general, the greater a subject's systolic elevation over base level, the smaller the proportion of complex melodies chosen.

However, choice was affected to a considerable degree by the particular task in which a subject was engaged while making choices and processing the chosen melodies. The digit–symbol and slides-memorization tasks were by far the most successful in reducing the preference for complex melodies. The contrast of these two conditions with the remaining three, $F(1, 89) = 11.09$, $p < .01$, accounted for virtually all of the variance due to the type of task; the residual was entirely negligible, $F(3, 89) < 1$.

The above contrast captures statistically and theoretically what we see as the essence of the differential effects of various activities performed concurrently with choice. The digit–symbol task and the task of closely attending to and memorizing details of paintings presumably demanded more processing capacity than other tasks; as a consequence, more capacity was allocated to these tasks (cf. Kahneman, 1973). Since complex stimuli are presumably more difficult to process than simple stimuli, and given that the option existed, subjects chose to expose themselves and process the less demanding additional stimulation (simple melodies) in order to avoid a processing overload.

Note that the arousal aspects of cognitive tasks were quite irrelevant. The slides-memorization subjects were far less aroused than the digit–symbol subjects, but chose as few complex melodies ($F < 1$). Also, the digit–symbol group was no more aroused than the contour-tracing group, but chose far fewer complex melodies, $F(1, 89) = 4.59$, $p = .035$. Finally, the slides-memorization subjects were as little aroused as those without the memorization instructions and those without any task at all; yet, the former group chose significantly fewer complex melodies than did the latter two groups, $F(1, 89) = 4.03$, $p = .048$. This converging evidence provided strong support for the processing-capacity position.

DISCUSSION

Overall, the evidence in favor of the processing-capacity position was diverse and detailed, and has led us to the following conclusions: (a) At least some activities that require little processing effort have no differential effect on choice, even though they raise the level of arousal (e.g., the contour-tracing condition); (b) a behaviorally identical activity may have a very pronounced effect on choice when it involves the processing of information (the digit–symbol treatment); (c) active processing of information, without any arousal components, may reduce the choice of complex melodies (e.g., the slides-memorization condition); and (d) at least in the present experiment, the increment in arousal level and decrement in the choice of complex melodies due to conceptual conflict were both negligible. Thus, processing factors, "uncontaminated" by the arousal-level considerations, had a direct and powerful effect on the choice of simple/complex melodies. This can be readily understood if the present experiment is regarded as a special case of a divided-attention situation. Our subjects had to process information from two sources during the same time period. One source of information (task) was "compulsory," and to it was allocated as much capacity as demanded (cf. Kahneman, 1973). However, subjects had a choice over what other information they would process (simple vs. complex melodies). Moreover, from the initial demonstration and early trials, subjects were aware of the relative complexity of the two types of melodies and of the respective processing effort required. Therefore, across conditions, subjects' choices may have been guided by the differential processing demands of the compulsory tasks, that is, by the amount of processing capacity unconsumed by these tasks. The greater the spare capacity (the smaller the likelihood of an overload), the greater the proportion of complex-melody choices, given that the two types of melodies were initially liked about equally. The two types had, of course, been specifically chosen to satisfy the latter requirement on the basis of the work of Crozier (1974), and Konečni et al. (in press). In the present experiment, this was confirmed by the mild stimulation–no-task subjects who made 54.37% of complex choices (56.17% in a similar condition of the study by Konečni et al.).

How does arousal fit in this scheme? After all, aversive stimulation (compared to mild) increased the level of arousal and decreased the proportion of complex-melody choices. Also, there was a significant negative correlation, across all subjects, between the increase in the level of arousal over base level and the proportion of complex-melody choices. Finally, procedural precautions had been taken to decrease the plausibility of application of the coping hypothesis, which can be interpreted as focusing on the processing of the aversive information itself and as treating the arousal-level increase as epiphenomenal. We suggest that whereas in some circumstances an arousal-level increase is an important determinant of choice, it may even then be a second-order determinant, mediated by the cognitive labeling processes (e.g., Konečni, 1975a, 1975b), and by a decrease in the available processing capacity. As mentioned previously, some sort of a decrement in processing capacity as a function of a high level of arousal has often been suggested (e.g., Broadbent, 1971; Easterbrook, 1959; Kahneman, 1973; Sokolov, 1963), and there is the additional—thoroughly uninvestigated, but reasonable—possibility that the cognitive monitoring of physiological changes may require processing effort. Such an analysis facilitates the interpretation of most of the present and many earlier findings in that it assumes that *both* a high level of arousal and the demanding cognitive tasks reduce the choice of complex patterns by virtue of decreasing the processing capacity. Whereas in principle it remains possible that arousal affects choice directly through an independent mechanism that bypasses the processing-capacity factors, this idea appears to lack both plausibility and parsimony. Not only is it unclear as to what the features of such a mechanism might be, but its output would still have to be combined at some point in the central nervous system with the effects of cognitive tasks—which have been shown to be mediated by the processing-capacity factors.

By no means should these conclusions be interpreted as stating that the choice involving simple/complex stimuli is governed solely by the processing-capacity factors. Just as the effect of arousal level may be mediated by the differential cognitive labeling and by the capacity variables, the effect on choice of the capacity factors themselves may perhaps be modified by the social context and certain tasks typically not encountered in the laboratory. There may be situations and "pleasant" tasks where people would actively seek a processing overload. An interesting additional modifier of choice emerged in the present experiment. The case in point was subjects' behavior over trials: Whereas the effect of aversive stimulation on blood pressure was far more effective early than late in the session (see Table 1), there was no effect of trials on choice ($F = 1.00$). Inspection of the individual curves revealed that this was true for the majority of subjects. Similar results were also obtained in the pilot study and the Konečni et al. (in press) study. An intriguing possibility is that the subjects' processing capacity was reduced by the early arousal-level increase, that this led to few complex-melody choices being made in the early trials, and that the same "choice set" was then maintained for the rest of the trials. Subjects thus seemed to ignore their actual physiological recovery and the presumed increase in spare processing capacity. We have data, not reported here, which show that a choice "recovery" also gradually took place; however, this occurred only after all tasks and stimulation had been removed, in a situation resembling the initial-preference trials.

To conclude that the choice involving simple/complex melodies is multiply determined would be an understatement. Nevertheless, in going beyond the general-arousal considerations and demonstrating the utility of application of the processing-capacity model, the present research may have clarified at least some aspects of the interaction between the cognitive and motivational determinants of choice. In addition, whereas the research hopefully addressed some issues more basic than those involved in *aesthetic* choice, it seems that our results are also relevant for music preference and appreciation: (a) Structural aspects of the melodies were musical (see Footnote 3), even though the melodies were not "real" compositions; (b) subjects were asked to follow their music preferences in choosing between melodies; and (c) subjects told us that they perceived the melodies as music and enjoyed them. Finally, the present divided-attention/choice paradigm may be treated as a loose analogue of many real-life situations where the type of music one chooses to listen to may in part be governed by the processing demands of the activity in which one is concurrently engaged.

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