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Channels and order of report in dichotic memory*

STANLEY R. PARKINSON†, MARK V. KNIGHT, JOSEPH C. DeMAIO, and JAMES F. CONNORS
Arizona State University, Tempe, Arizona 85281

Experiments were conducted in which Ss received to-be-remembered sequences of two, three, or four simultaneous pairs of digits. Both digits of each pair were recorded by the same male speaker and both were presented binaurally, thus eliminating cues of spatial location and voice by which Ss could "channel" their reports. Even in the absence of these stimulus channels, Ss reported the digits sequentially. High bias ratings in the first experiment suggested the possibility that sequential reports were induced by uncontrolled stimulus characteristics (e.g., temporal synchrony, intensity, and pitch). Pulse-coded speech stimuli, which provided greater control over nonlinguistic stimulus features, were used in the terminal experiment. Bias ratings were reduced, but the majority of Ss continued to report sequentially. These results suggest that the presence of stimulus channels is not a necessary condition for the occurrence of sequential reporting.

In the most commonly employed variant of the dichotic memory task, Ss receive a sequence of simultaneous pairs of digits, one member of each pair delivered to the right ear and one to the left ear, with instructions to reproduce, in the order of their choice, as many of the digits as possible. Given rapid stimulus presentation, highly consistent recall patterns are obtained with this experimental procedure (e.g., Broadbent, 1954; Bryden, 1962). There are two important aspects of these recall patterns: first, the reports are sequential, i.e., Ss report one digit from the first pair received, then one digit from the second pair, and one digit from the third pair. This set of digits (sometimes called the first half-set) is followed in recall by the remaining members of the first, second, and third pairs, respectively. Second, recall is "channeled" or grouped according to spatial location. The Ss recall all of the digits received by the right ear followed by those presented to the left ear, or vice versa. If both members of each digit pair are presented binaurally (thus removing the cue of spatial location) but are made to differ along dimensions of pitch or intensity, Ss still report sequentially and their reports are channeled according to those dimensions (Broadbent, 1956).

While "channel-by-channel" reporting has formed the basis for models of memory and attention (e.g., Broadbent, 1958, 1971; Yntema & Trask, 1963), the relation between sequential reporting and channeling has received relatively little interest. The purpose of the present research is to determine whether the presence of channels is a necessary condition for the occurrence of sequential reporting.

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†Requests for reprints should be sent to Stanley R. Parkinson, Department of Psychology, Arizona State University, Tempe, Arizona 85281.

In previous research directed toward this question, Savin (1967) changed the usual dichotic paradigm by presenting both recorded messages over a single loudspeaker. Stimulus lists consisted of two pairs of digits recorded by the same speaker, thus channels, in the sense in which they have been defined (intensity, pitch, and spatial location), were effectively eliminated in this experiment. If channels were necessary for sequential reporting, the consistency of sequential reporting in Savin's experiment should have been much decreased relative to traditional experiments given the presence of channels (e.g., Broadbent, 1954; Bryden, 1962). Savin (1967), however, found consistent sequential reporting in his experiment. The Ss reported one member from the first pair, then one from the second, followed in turn by the remaining members of the first and second digit pairs. Savin interpreted his findings as showing the irrelevance of channel-defining characteristics to the preferred order of report, and explained his result by stating that the tendency to group sequentially was a fundamental property of the auditory system. While Savin's findings are of major importance, they must be considered with caution. In his study, only two pairs of digits were employed, rather than the three or more pairs generally used in dichotic studies, and the accuracy of reporting was quite low (only 61% of the trials were perfect reports).

The present experiments were conducted in order to further investigate the relation between channels and order of report. In these experiments, lists consisting of two, three, and four pairs of digits were presented to both ears (binaurally), thus eliminating channels as in the Savin (1967) experiment. In view of the recent demonstration that grouping Ss according to their immediate memory span as measured by a conventional digit span test accounted for approximately 80% of the variance in a dichotic memory task (Parkinson, 1974), Ss in the present experiments were so grouped and the relation between digit span and accuracy of report was investigated.

EXPERIMENT I

Method

Subjects. Fifteen introductory psychology students served as Ss in the present experiment. They received course credit for their participation.

Materials and Procedure. Prior to S's participating in the experimental session, individual single-channel digit spans were assessed. Three digit span tests were taped, each tape consisting of two sets of randomly ordered digits for each of the list lengths 3 to 14. Digits were selected from the set of 0-9 and were presented at the rate of 2 digits/sec. A 10-sec interval separated adjacent lists. The Ss were instructed to listen to each set of digits and, during the interval following the presentation of the last digit, to repeat them back to E in the same order in which they were presented. Each digit span test proceeded until S failed to report both sets of a particular list length in the order in which they were presented. The S's digit span for a test was defined as one less than the list length of the two sets he failed to report in order. Three such estimates of span were taken and the mean of these three tests, rounded to the nearest integer, was defined as the S's digit span. There were digit span groups of 6, 7, and 8 represented in this experiment, with five Ss in each group.

Following the digit span tests, Ss were presented with binaural lists. Each trial consisted of two simultaneous pairs of digits presented at the rate of 2 pairs/sec, with a 10-sec intertrial interval. Digits (0-9) were randomly ordered, with the constraint that the same digit never occur more than once on any one trial. The two digits of each pair were recorded by the same male speaker on different tracks of a stereo tape deck (Sony TC 366). During the experimental session, both digits of each pair were played binaurally to the S over headphones (Superex Pro BV), producing a sensation of localization of the simultaneous pair in the middle of the head.

The Ss were told that they would be presented with four digits in a short period of time. They were instructed to verbally report the digits to E during the interval at the end of each trial in whatever order they preferred. There were 42 total trials for each S, the first 12 of which were practice trials; the remaining 30 were experimental trials.

Results

If channels (i.e., differences in spatial location) were necessary for sequential reporting, patterns of recall in the present experiment should be more variable than in experiments in which distinct channels were present. This, however, was not the case. There were 450 test trials, of which 410, or 91%, were recalled perfectly. Of the 410 perfect trials, 386, or 94%, were sequential reports (one digit from the first pair followed by one digit from the second pair, then the remaining digits from the first and second pairs, respectively); 16 trials were pair-by-pair, or temporal, reports (both digits of the first pair followed by both digits of the second pair); and 8 were equivocal reports (the first two digits were reported sequentially as were the subsequent two, but one of the successive pairs was in reverse order). These results further substantiate the effect noted by Savin (1967), but with much higher accuracy levels. Table 1 shows the realtive frequency with which the three orders of report were used and the high levels of accuracy obtained by all Ss.

Table 1
Percent of Total Trials Reported Perfectly as a Function of Order of Report and Digit Span: Binaural Twos

Digit Span Group	Order of Report		
	Sequential	Temporal	Equivocal
6	80.0	6.0	2.0
7	87.3	2.0	1.3
8	90.0	2.7	2.0

While there was a trend indicating accuracy of report to vary as a function of digit span, differences between groups were not reliable, $F(2,12) < 1$. This was not unexpected, as only two pairs were used and the four items were within the digit span of all groups.

The sequential report was the preferred order of report. Perhaps there were artifactual channels in the recording which biased this result. If this were true, there should have been a noticeable tendency on sequentially reported trials for Ss to report together digits recorded on the same track. For these trials, the probability of grouping a digit from the first pair with a digit from the second pair—both digits having been recorded on the same track—was 0.63, $t(14) = 1.032$, $.30 < p < .40$. A digit recorded on one track of the tape, then, was as likely to be grouped with a digit recorded on the other track as with one recorded on the same track.

The results of this experiment and Savin's (1967) study show that the sequential report is the preferred order of report even in the absence of channels based on spatial location and voice. However, only two pairs of digits were used as opposed to the three or more generally used in dichotic studies. Therefore, to investigate the stability of sequential reporting with increased list length and possible relationships to digit span, the second experiment was conducted using sequences of three and four simultaneous digit pairs.

EXPERIMENT II

Method

Forty students drawn from introductory psychology classes served as Ss. Five digit-span groups were represented: 6 ($N = 10$), 7 ($N = 10$), 8 ($N = 10$), 9 ($N = 5$), and 10 ($N = 5$). Five Ss in the 6-, 7-, and 8-digit-span groups ($N = 15$) were given binaural lists consisting of three simultaneous pairs. The remaining Ss in the 6, 7, and 8 groups and the Ss in the 9- and 10-digit-span groups ($N = 25$) were given four simultaneous pairs. Lists were prepared and presented as in Experiment I, with Ss being instructed to report the digits in whatever order they preferred.

Results

Three Pairs. The percentage of perfect trials varied as a function of digit span. The Ss in the 6-digit-span group recalled 27.3% of the trials without error, those in the 7-digit-span group recalled 53.3% of the trials perfectly, and the 8-digit-span group recalled 62% perfectly. An analysis of variance indicated these differences between digit-span groups to be reliable, $F(2,12) = 4.60$, $p < .05$.

Table 2
Percent of Perfect and Nonperfect Trials as a Function of Order of Report and Digit Span: Binaural Threes

Digit Span Group	Order of Report					
	Sequential		Temporal		Equivocal	
	Perfect	Nonperfect	Perfect	Nonperfect	Perfect	Nonperfect
6	23.3	43.3	0.7	4.7	3.3	24.7
7	51.3	34.0	0	2.0	2.0	10.7
8	60.7	34.7	0	0	1.3	3.3

Collapsed over digit span, 214, or 48%, of the 450 experimental trials were recalled perfectly. Of the 214 perfect trials, 203, or 94.9%, were sequential reports; 1 perfect trial was achieved by temporal, or pair-by-pair, reporting; and 10 trials were classified as equivocal. Again the data are supportive of the previous findings of Savin (1967).

As slightly less than one-half of the trials were recalled without error, report categories were broadened to include nonperfect trials. We thought that when Ss erred on a trial in many cases their report would be detailed enough to reflect the operation of a report strategy. Only the first three digits reported were used in the classification of nonperfect trials. If the first three digits reported came from the first, second, and third pairs, respectively, the report was classified as nonperfect sequential. If the first two digits were both members of the first pair and if the third was a member of the second pair, the report was classified as nonperfect temporal. If the first three digits reported could not be so classified, or if an error (extralist intrusion) was made in the first three digits, the report was defined as nonperfect equivocal. The advantage of this reclassification of nonperfect trials is that 100% of the data is included in the analysis. The nonperfect trials are included for each digit-span group in Table 2. Again the results are clear, i.e., the combination of perfect and nonperfect sequential reports accounts for 66.7% of the 6-digit-span reports, 85.3% or the 7-digit-span reports, and 95.3% of the 8-digit-span reports. The sequential order of report is further shown to be the preferred order of report when there are no channels.

Four Pairs. The percentage of trials recalled perfectly by the 6-, 7-, 8-, 9-, and 10-digit-span groups was, respectively, 10.7%, 10.7%, 22%, 53.3%, and 51.3% (see Table 3). The differences between span groups were reliable, $F(4,20) = 6.40$, $p < .005$.

Collapsing over digit span, only 222, or 29.6%, of the 750 experimental trials were recalled perfectly. Of these, 153, or 68.9%, were sequential; 18, or 8.1%, were temporal; and 51, or 22.2%, were equivocal. These data, with one exception, are much like those for the three-pair condition. The exception is that, in the 8-digit-span group, a greater percentage of perfect trials was achieved with a temporal report than with a sequential report. This anomaly was due to one S, who attempted to report temporally and did so perfectly on 10 of 30 experimental trials. Nonperfect trials were brought into the analysis for a more comprehensive look at the orders of report. A report was defined as nonperfect sequential if the first four digits reported came from each of the successive simultaneous pairs (i.e., one digit from the first pair followed by one digit from the second pair, one digit from the third pair, and one digit from the fourth pair). A report was defined as nonperfect temporal if the first two digits reported were both members of the first pair and if the third and fourth digits were both members of the second stimulus pair. Trials in which the first four digits could not be so classified were combined in a nonperfect equivocal category. As can be seen in Table 3, the combined perfect and nonperfect sequential reports account for a greater percentage of trials than the combined perfect and nonperfect temporal in all digit-span groups. However, over one-half of the trials in the 6-, 7-, and 8-digit-span group remain equivocal. As in previous studies on digit span and dichotic memory (Parkinson, 1974), there is a marked discontinuity in performance as digit span is equaled and exceeded by binaural list length.

The absence of channels in the three-pair and

Table 3
Percent of Perfect and Nonperfect Trials as a Function of Order of Report and Digit Span: Binaural Fours

Digit Span Group	Order of Report					
	Sequential		Temporal		Equivocal	
	Perfect	Nonperfect	Perfect	Nonperfect	Perfect	Nonperfect
6	1.3	8.0	0.7	4.0	8.7	77.3
7	7.3	33.3	0.7	3.3	2.7	52.7
8	6.0	31.3	6.7	3.3	9.3	43.3
9	44.0	27.3	4.0	0	5.3	19.3
10	43.3	29.3	0	2.0	8.0	17.3

four-pair recordings was determined as in the two-pair experiments. The probability of grouping a digit from the first pair with a subsequent digit recorded on the same track was no more likely than grouping with a digit recorded on a different track (all $t_S < 1$). Thus the sequential order of report cannot be considered as a result of artifactual channels in the recording.

Discussion

These findings are in agreement with the demonstration by Savin (1967) that, even in the absence of channels based on voice and spatial location, Ss prefer to report binaural speech stimuli sequentially. This preference has been shown to be reliable for three and four pairs in addition to the two pairs previously investigated. Savin (1967) has stated that channel-defining stimulus properties are irrelevant to the preferred order of report. The tendency to group sequentially, he argues, is a fundamental property of the auditory system. While the results of the present experiments agree with and extend Savin's findings, there are other possible explanations for the tendency to group sequentially items that are presented simultaneously.

Savin's statement that channel-defining stimulus properties are irrelevant to S's tendency to report sequentially is based on the assumption that channels are defined exclusively as spatial location and voice. However, it can be argued that these are not the only stimulus properties defining channels available to Ss. There are nonlinguistic properties (e.g., intensity, synchrony, and pitch) and linguistic properties (phonetic differences between simultaneous digits; see Studdert-Kennedy, Shankweiler, & Pisoni, 1972) which could be selected as channels.

If stimulus cues are available on a trial and if Ss use those cues to order digits in recall, there should be a tendency for Ss to group digits in the same pattern. In order to determine if this was the case in the present research, a bias index was calculated for each trial in the two-pair experiment. The numerator of the bias index was the frequency of the modal recall pattern for a trial, while the denominator was the number of Ss recalling that trial without error. The obtained bias indices ranged from .286 to .857 with a mean of .540.

Evaluation of the magnitude of the bias index depends on assumptions about the number of potential recall patterns and their associated probabilities. Given four digits, there are 4!, or 24, possible recall patterns. We assumed that the first digit reported would always be a member of the first digit pair (a condition which is true for both sequential and temporal reports). This assumption restricts the number of recall patterns to 12. Second, we assumed equiprobability of the 12 patterns. Given these assumptions, the bias index in the two-pair experiment had a theoretical range (considering trials in which all 15 Ss achieved perfect reports) from .13 (most frequent pattern occurred twice) to 1 (all 15 Ss reported the digits in the same sequence). In light of the range of the bias index, we can see that the bias ratings obtained in the two-pair experiment were quite high. In fact, the mean bias index, .540, indicates that on the average trial in which 15 Ss reported all four digits correctly, 8 of the 15 Ss recalled the digits in the same sequence.

The possibility exists that sequential reports in the present experiments were induced by stimulus cues. In the next experiment, we used pulse-coded speech stimuli which provided greater control over such nonlinguistic factors as temporal synchrony, intensity, and pitch. If the high bias ratings in the two-pair experiment reflect the use of nonlinguistic cues, bias ratings in the present experiment should be decreased. If sequential reports are indeed independent of stimulus channels, sequential reporting should still be reliable.

EXPERIMENT III

Method

Stimuli. Digits 1-6 and 8-10 were first recorded on one channel of a Sony TC-366 stereo tape recorder. The digits were then filtered (5 kHz low pass) and input one at a time to a PDP-15 computer via a 12-bit analog-to-digital (A/D) converter. The computer was programmed to begin receiving data whenever the intensity of the input exceeded a threshold, which was set empirically to be as low as possible. Input was sampled at a rate of 10 kHz, and sampling continued until core was filled. The pulse-coded representation was then stored on DECtape.

After all digits had been recorded, they were equated for duration by using only the first 4,000 points of the data array. Thus each digit had a duration of 400 msec; the digit 6 was excluded because its duration was less than 150 msec. Next, the digits were equated for total energy. This was done by squaring each point and summing over the 4,000 points. All digits were then scaled to the level of the least intense (accurate to three significant digits).

The dichotic tape was generated by outputting digits simultaneously through two digital-to-analog (D/A) converters (12-bit). The output of the D/As was passed through separate filters (5 kHz low pass), attenuators, and mixer-preamplifiers and recorded on two channels of the Sony TC-366. Equality of levels on the two channels was verified by passing a sine wave through the filter-attenuator-mixer circuit and adjusting the attenuators according to the VU meters of the tape recorder.[1]

This procedure removes three cues which Ss might potentially use to define channels. These are onset and offset asynchrony (less than 7 μsec) and overall intensity (energy). Two classes of attributes of the digits remain uncontrolled and might serve as channel cues. These are qualities of the formants within the digit (e.g., intensity or duration of specific formants) and qualities of temporal subintervals of the digit (e.g., total intensity of the first 100 msec, time to peak intensity). Although these features were not controlled, they were identical on each presentation of the digit, thus rendering them more amenable to statistical control.

Two test tapes were prepared, each with 100 dichotic lists. The first tape consisted of lists with two pairs, and the second with lists of three pairs. Stimuli were selected from the digit set 1-5 and 8-10. The order of digits was randomized, with the constraint that no number appear more than once on a trial.

Subjects and Procedure. Twenty-five introductory psychology students served as Ss in the present experiment, and they were given course credit for their participation. Digit spans were assessed, and five groups of Ss (representing spans 5, 6, 7, 8, and 9) were selected.

Each S received 100 trials with two pairs and 100 trials with three pairs, in that order. The first 50 trials for each list length of each session were regarded as practice and were not included in statistical analyses. The second 50 trials of each test were scored. As in the previous experiments, stimuli were presented binaurally and Ss were instructed to report the digits in whatever order they found easiest.

Results

As in the first two experiments, the results of the present experiment, employing a free recall procedure, produced a majority of sequential reports in the absence of channels. The number of trials reported without error is shown for each S in the two-pair and three-pair conditions in Tables 4 and 5, respectively.

Two Pairs. Even though each S was given 50 practice trials prior to testing, the pulse-coded digits proved to be more difficult than normal speech. There were 1,250 trials (25 Ss, 50 trials/S), and 1,024, or 81.9%, were perfect reports (compared to 91% in the first experiment with two-digit pairs). As in the three- and four-pair conditions, accuracy of reporting was a reliable function of digit span, $F(4,20) = 4.84$, $p < .01$. Of the perfect trials, 735, or 71.8%, were sequential reports; 221, or 21.6%, were temporal, or pair-by-pair, reports; and 68, or 6.6%, were equivocal.

Bias indices were computed for each of the 50 test trials. As for the first two-pair experiment, the bias index was a ratio of the most frequently occurring recall pattern to the number of Ss recalling that trial without error. The obtained bias indices ranged from .18 to .55, with a mean of .35. The pulse-coded stimuli removed cues of onset and offset asynchrony and overall intensity. The reduction in magnitude of the bias index with pulse-coded stimuli relative to that obtained with normal speech (mean of .540) suggests that these cues were available in the first experiment and that Ss used them in ordering digits in recall. However, the finding that over 70% of the perfect reports in the present experiment were sequential suggests that the majority of Ss select this pattern independently of stimulus channels.

The main difference between the results of the present experiment and those of the first two experiments lies in the increased percentage of temporal reports (3.9% in the first experiment and 21% in the present experiment). In this regard, it is interesting to note that the results of the present experiment are more comparable to those obtained by Savin (1967). Considering only unequivocal perfect reports, Savin found 79% of the trials were sequential and 21% were temporal. Savin also found that temporal reports were not distributed evenly over all Ss. Nine of his 15 Ss reported sequentially at least 90% of the time. For his other 6 Ss, this percentage ranged from 67% to 0. The same pattern was found in

Table 4
Number of Perfect Trials for Each Subject as a Function of Order of Report and Digit Span: Pulse-Coded Twos

Digit Span Group	Ss	Total Number of Perfect Trials (50 Possible)	Order of Report S	T	E
	S 1	41	41	0	0
	S 2	45	14	30	1
9	S 3	49	47	1	1
	S 4	48	47	0	1
	S 5	47	45	1	1
	S 1	48	48	0	0
	S 2	45	39	2	4
8	S 3	36	33	2	1
	S 4	50	47	2	1
	S 5	49	45	0	4
	S 1	44	24	14	6
	S 2	45	45	0	0
7	S 3	43	12	16	15
	S 4	39	1	38	0
	S 5	46	43	1	2
	S 1	42	39	2	1
	S 2	40	35	3	2
6	S 3	33	23	5	5
	S 4	45	23	19	3
	S 5	32	2	29	1
	S 1	34	13	18	3
	S 2	43	39	2	2
5	S 3	14	3	7	4
	S 4	32	13	13	6
	S 5	34	14	16	4

Note–S = sequential, T = temporal, E = equivocal

Table 5
Number of Perfect Trials for Each Subject as a Function of Order of Report and Digit Span: Pulse-Coded Threes

Digit Span Group	Ss	Total Number of Perfect Trials (50 Possible)	Order of Report S	T	E
	S 1	32	28	0	4
	S 2	42	23	1	18
9	S 3	38	30	0	8
	S 4	42	36	0	6
	S 5	44	41	0	3
	S 1	46	41	0	5
	S 2	23	1	4	18
8	S 3	18	14	0	4
	S 4	33	22	2	9
	S 5	34	17	0	17
	S 1	27	12	0	15
	S 2	39	18	4	17
7	S 3	38	0	22	16
	S 4	29	0	10	19
	S 5	26	9	1	16
	S 1	33	11	0	22
	S 2	28	5	6	17
6	S 3	24	3	1	20
	S 4	31	0	3	28
	S 5	8	0	0	8
	S 1	8	1	0	7
	S 2	30	10	0	20
5	S 3	20	0	1	19
	S 4	9	1	0	8
	S 5	17	1	4	12

Note–S = sequential, T = temporal, E = equivocal the present experiment. In the first experiment with two pairs, all Ss showed a modal pattern of sequential reporting. In the present experiment, 17 of the 25 Ss showed a modal response of sequential reporting; 7 had a modal pattern of temporal reports (see Table 4). The 7 Ss showing a modal temporal report accounted for 154, or approximately 70%, of the 221 temporal reports. From these results and from those of Savin (1967), it would appear that a certain proportion of the population (approximately 20%) prefers temporal reports. The main point to be argued here is that even with greater precision and control over stimulus variables such as temporal synchrony, total stimulus energy, and duration, the majority of Ss reported sequentially.

Three Pairs. As in the two-pair condition, accuracy in three-pair reporting varied as a function of digit span, $F(4,20) = 5.03$, $p < .01$, with a range from 79% in the 9-digit-span group to 33% in the 5-digit-span group. Collapsed over digit span, 719 of 1,250 trials, or 45.1%, were sequential, 59, or 8.2%, were temporal, and 336, or 46.7%, were equivocal.

Compared to the two-pair condition and to the first two experiments, the number of sequential reports in the three-pair conditions dropped precipitously. As mentioned previously, the pulse-coded digits were more difficult to process than normal speech. It is possible that Ss were trying to report the digits sequentially or temporally, but "lost track" due to the difficult nature of the task. As equivocal perfect trials constituted such a great percentage of the total, we looked at equivocal trials in more detail. We reclassified equivocal reports solely on the bais of the first three digits reported. If it were the case that Ss were attempting to report sequentially or temporally, but "lost track" of position due to the number of items, the first three digits reported should reveal those patterns. If the first three numbers reported were from the first, second, and third pairs, respectively, the report was classified as attempted sequential. If the first two digits reported were both from the first pair received and if the third reported digit was a member of the second pair, the report was classified as attempted temporal. Combining these reports with the perfect sequential and temporal reports, we find that 468/719, or 65%, of the trials were sequential or attempted sequential and 105/719, or 14.6%, were temporal or attempted temporal. The remaining 20.4% of the equivocal trials recalled without error did not fall into the above categories. Table 6 shows the most commonly observed response patterns in equivocal trials. Classification is based only on the first three digits reported. Several points of interest emerge from Table 6. First, there are many possible response patterns, but most of them simply do not occur. Only 2% of the trials did not fit into the class of response patterns in which the first digit reported was a member of the first pair presented. When these infrequent patterns did occur, they were always in Digit-Span Groups 7, 6, and 5. No such patterns were shown by the 8- and 9-digit-span groups. Second, the total number of response patterns varied as a function of digit span. The 9-digit-span group showed five patterns; the 8-digit-span group, 6; the 7-digit-span group,8; the 6-digit-span group, 9; and the 5-digit-span group, 11. The increased variability of patterns as we move from high to low digit span appears to be due to the amount of overloading. For some reason, when the number of items exceeds span, the saliency of the "temporal tags" is decreased.

We also classified the nonperfect trials as in the second experiment. Of the 531 nonperfect trials, 302 were reclassified as nonperfect sequential, 62 as nonperfect temporal, and 167 as nonperfect equivocal. Combining these data with perfect trials, we found 770, or 61.6%, sequential; 167, or 13.4%, temporal; and 25.0% equivocal.

DISCUSSION

In summary, the results of the present experiments and those of Savin (1967) provide a rather convincing demonstration that sequential reporting occurs reliably in the absence of stimulus channels. As channel-defining characteristics were systematically reduced, recall patterns retained their sequential nature. These results indicate that channels are not necessary for sequential reporting.

Savin (1967) maintained that the tendency to group stimuli sequentially was a fundamental property of the auditory system, and the present results are clearly in accord with that hypothesis. However, while it is clear that the majority of Ss report sequentially, it is of interst that some of the individuals sampled in the present research and in that of Savin (1967) reported temporally, or pair-by-pair, under conditions of rapid presentation. This characteristic appears to be independent of digit span, as with pulse-coded two-pair stimuli; Ss showing a majority of temporal reports were found in four different digit-span groups.

Table 6
Number of Equivocal Reports as a Function of Response Pattern and Digit Span (Three-Pair Condition, Experiment III)

Response Pattern	Digit Span Group 9	8	7	6	5	Total
1, 2, 3 (AS)	25	31	28	34	26	144
1, 2, 1	–	2	11	19	12	44
1, 2, 2	5	5	16	23	11	60
1, 3, 1	–	1	–	2	1	4
1, 3, 2	1	–	2	2	4	9
1, 3, 3	–	1	1	–	1	3
1, 1, 2 (AT)	4	12	16	7	7	46
1, 1, 3	4	1	8	6	–	19
Other	–	–	1	2	4	7
Total	39	53	83	95	66	336

Further research on these individuals is clearly warranted in light of the importance of recall patterns in models of dichotic performance (e.g., Broadbent, 1971).

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