DURATION AND GROUPING IN AUDITORY EVENTS

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Abstract

There is ample literature on the influence of nontemporal variables on temporal properties of events (Allan, 1979). In the present research, it was hypothesised the influence of the vertical segregation of an auditory event on the global duration of the sequences. Two experiments were carried out in which the method of adjustment was used. In the first experiment the stimuli were sequences of three elements. Results demonstrated that the stimulus onset asychrony-within (SOA-within) decreases when an "empty" interval is placed between two sounds. In the second experiment, a white noise was placed between or after two sounds. Data analysis showed a significant reduction of perceptual duration in sequences with vertical segregation of the white noise. These results suggest that temporal dimension of the sequences is related to the perceptual grouping of the auditory events.

It is well-known that intervals having the same physical duration are not necessarily judged as equal in perceived duration. In many cases, the judgment depends on the nontemporal characteristics of the stimuli (Allan, 1979). For example: a filled auditory interval is perceived as longer than an empty interval of identical physical duration (Craig, 1973); several auditory filled intervals alternating between two intensities and frequencies are judged as longer than constant filled intervals (Brown and Hitchcock, 1965). In the present research, it was hypothesized the influence of the vertical segregation of an auditory event on the global duration of the sequences. I have considered the following auditory sequence studied by Vicario (1963): sound (440 Hz, 100 msec), white noise (35 msec), sound (392 Hz, 100 msec). The experimental subjects claimed the white noise is temporally displaced. In this sequence, according to Vicario (1999), there is a vertical segregation of the white noise because the sounds tend to be grouped by the law of similarity (Werheimer 1923; in auditory field see Bozzi and Vicario, 1960; Bregman, 1990) (see Figure 1).

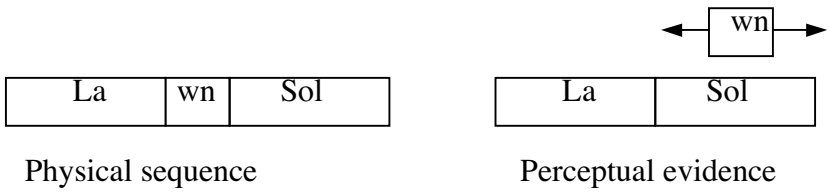

Figure 1. The physical sequence La (100 msec), white noise (35 msec) and Sol (100 msec) is perceived as two sounds grouped together and the white noise positively dislocated on a different tonal plane.

Two experiments were carried out in order to establish whether the temporal dislocation, on a different tonal plane, influences the perceptual duration of the global sequence.

Experiment I

Method

Stimuli. The participants were 10 students from the University of Padua with declared normal hearing. The signals were synthesized by the Sound Edit 16 for Macintosh software. Stimuli were generated by an Apple Power Macintosh 9600/350, amplified by a Technics SU-V560 power amplifier and presented through headphones (Sennheiser HD 570). Participants responded by using a computer keyboard. The experiment took place in an isolated room. The stimuli were three sequences: (A) *La* 440 Hz, 100 msec; *Lab* 415.3 Hz, 35 msec; *Sol* 392 Hz, 35 msec. (B) *La* 440 Hz, 100 msec; 35 msec; *Sol* 392 Hz,100 msec; (C) *La* 440 Hz, 117,5 msec; *Sol* 392 Hz, 117, 5 msec. Sounds included onset and offset ramps that were linear changes in amplitude: a 50 msec offset ramp up to 60 dB and then an immediate decline in amplitude during a 50 msec offset ramp.
Procedure. The method of adjustment was used. A sound of 440 Hz, 35 or 435 msec, served as comparison stimuli. It was presented before and after the stimulus standard. 12 sequences (3 sequences x 4 repetitions) were presented to each participant in an individually randomised order.

Results and Discussion

An analysis of variance (ANOVA) was performed on the mean values of PSE. A within-subjects factor Sequence (A, B, C) were considered (Figure 3).

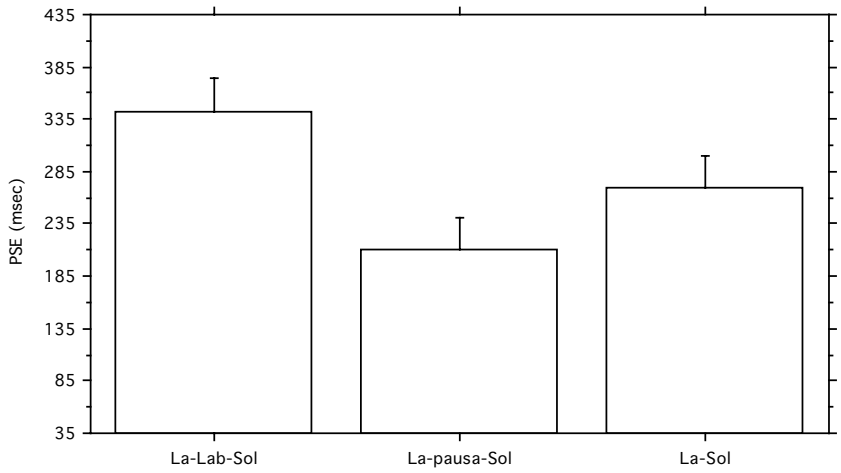

Figure 3. Mean values of PSE are reported on the ordinate. The auditory sequences A, B, C, are reported on the abscissa.

The analysis showed that the effect of the variable Sequence was significant ($F_{2,18}$= 23.85, p< .001), indicating that the sequence A was perceived as being longer than the sequence B and C. Sequence B was perceived as shorter than sequences A and C. Comparisons for different sequences were made: A *versus* B ($t_{1,9}$= 6.48, p< .001); A *versus* C ($t_{1,9}$= 3.89, p< .01); B *versus* C ($t_{1,9}$= -3.23, p< .02). Regarding the number of sounds, it is well documented that judged duration increases with the number of intervening elements (Allan, 1979). Results demonstrated also that the stimulus onset asychrony-within (SOA-within) decreases when an "empty" interval is placed between two sounds (Sequence B). This effect is consistent with other findings in literature (Craig, 1973).

Experiment II

Method

Stimuli. The participants were 10 students from the University of Padua with declared normal hearing. The material and the procedure were the same as in the previous experiment. The stimuli were four sequences: (D) *La* 440 Hz, 100 msec; white noise, 35 msec; *Sol* 392 Hz, 35 msec. (E) *La* 440 Hz, 100 msec; *Sol* 392 Hz, 100 msec; white noise, 35 msec. F and G were composed by two distal sequences: (F1) *La* 440 Hz, 117.5 msec; *Sol* 392 Hz, 117.5 msec and (F2) 100 msec; white noise, 35 msec. (G1) La 440 Hz, 100 msec; Sol 392 Hz, 100 msec and (G2) 82.5 msec; white noise, 35 msec.

Results and Discussion

The difference between the mean values of PSE of each condition was tested with a within-subjects ANOVA (Figure 5).

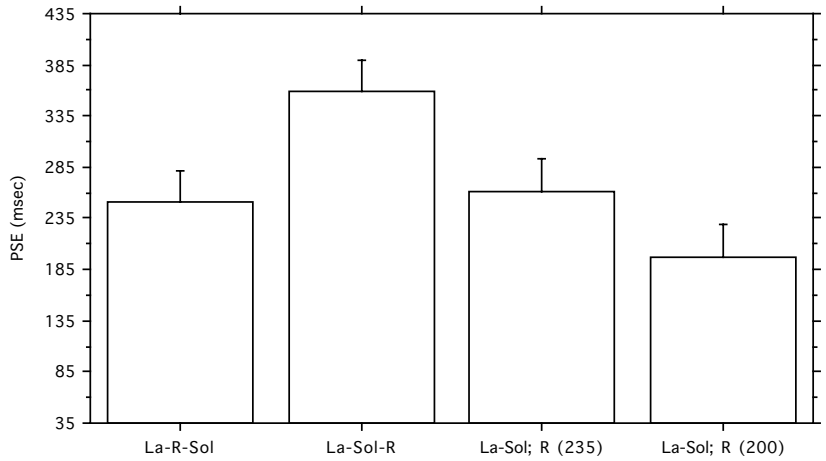

Figure 5. Mean values of PSE are reported on the ordinate. The auditory sequences D, E, F, G, are reported on the abscissa.

The analysis showed that the effect of the variable Sequence was significant ($F_{3,27}$= 13.46, p< .001). Comparisons for different sequences showed a significant difference between D and E ($t_{1,9}$= -3.97, p< .01); E and F ($t_{1,9}$= 2.68, p< .05); E and G ($t_{1,9}$= 10.14, p< .001); D and G ($t_{1,9}$= 2.79, p< .05); F and G ($t_{1,9}$= 2.34, p< .05); D and G ($t_{1,9}$= 2.78, p< .05). Difference between D and F was not significant ($t_{1,9}$= -.41, p= .686). These results showed a significant reduction of perceptual duration in sequences with vertical segregation of the white noise (sequence D). Second, these results are consistent with the results of experiment 1, in which sequences with filled auditory intervals were perceived longer than sequences with empty intervals. Finally, the present research has shown that temporal dimension of the sequences is related to the perceptual grouping of the auditory events (see also Sinico, 2004).

These results are also discussed in order to point out the role of vertical organization of auditory events in relationship to the effect of nontemporal variables on time duration.

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