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Title: Promotion of Stream Segregation by Deviants and Distractors

Background: Sequences of repeating, interleaved high and low tones are perceived to separate into distinct streams in a process known as build up of stream segregation (van Noorden 1975, Bregman 1978). Sudden changes in the sound sequence can cause a re-setting of build up; see Moore & Gockel (2012) for a review. This resetting of build up can occur with changes in location or loudness of the streams (Rogers & Bregman 1998), with the introduction of deviant tones in timing, frequency or loudness (Haywood and Roberts 2010) or with gaps in the tone sequences (Beauvois & Meddis 1997, Denham et al 2010).

Methods: Eight subjects listened to short presentations of a repeating ABA-triplet stimulus and subsequently reported their percept as either integrated or segregated. In control conditions the stimulus had three or six test triplets. During test presentations the stimulus had six triplets, either with a frequency deviant replacing the third triplet’s B tone, or with a distractor tone inserted during the silence following the third triplet (Fig 1A). Base frequencies were roved between trials and the inter-trial interval chosen to avoid carry-over and adaptation effects between trials.

Results: In control conditions the proportion segregated increased for longer presentations and increased for larger DF (Bregman 1978, Anstis & Saida 1985). In deviant and distractor conditions, there was no reset to integrated, but rather a significant increase in the proportion of segregation (Fig 1B). The deviant and distractor showed equivalent effects in promoting stream segregation. The demonstrated effect is opposite to the reset reported in Haywood and Roberts (2010) for a frequency difference deviant. Our paradigm differs in that the deviant (or distractor) tone occurs during an ongoing triplet sequence rather following an induction sequence (e.g. preceding A tones that induce segregation in the test sequence of triplets). We found further that the demonstrated promotion of segregation occurs only when the distractor’s frequency is sufficiently close to that of the B tone (<5st away).

Conclusion: We found, distinguished from previous reports, that sudden stimulus changes can promote segregation during build up. Further work should be directed at teasing apart the classes of stimulus manipulations that disrupt build up through reset to integration (Moore and Gockel 2012) or promote stream segregation as demonstrated here.
Figure 1: A: Stimulus paradigm. Repeating ABA-triplet stimulus with 100 ms tones (with 10 ms cosine on and off ramps) followed by 100 ms gap (total length of triplet unit with gap is 400 s). Low A and high B tones are separated by a DF of 4, 7 or 10 st. Control conditions consist of 3 or 6 triplets. In the deviant condition the third B tone is shifted up by 2 st. In the distractor condition an additional 50 ms tone is inserted in the silent gap after the third triplet. B: Psychoacoustic results. Each condition was repeated 20 times per subject. Percentage stream segregation is mean across $N = 8$ subjects with SEM shown. Stream segregation (SS) increases with DF in all conditions. SS increases with longer presentation (compare dashed grey with solid grey). SS increases in Deviant condition (compare solid black with dashed grey) and in Distractor conditions (compare dashed black with dashed grey).