Journal of Experimental Psychology: General

What You See Depends on What You Hear: Temporal Averaging and Crossmodal Integration

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Online First Publication, September 13, 2018. http://dx.doi.org/10.1037/xge0000487

American Psychological Association

2018

0096-3445/18/$12.00

10.1037/ 0000487

(PKU-IDG/McGovern Institute for Brain Research)

[illegible] (K[illegible], L[illegible], B[illegible], & W[illegible], 2011). T[illegible] (G[illegible], G[illegible], & B[illegible], 2005).

A [illegible] (B[illegible], 2017; G[illegible] & M[illegible], 1959; K[illegible], 1945; S[illegible], 1964): [illegible]. T[illegible] (R[illegible], 2003). Q[illegible] B[illegible] (R[illegible], H[illegible], & M[illegible] Gr[illegible], 2006), [illegible]. A[illegible] (M[illegible], C[illegible], & H[illegible], 1981) [illegible] (W[illegible], D[illegible] H[illegible], & W[illegible], 1986), [illegible] (B[illegible], D[illegible] R[illegible], & M[illegible], 2013).

I[illegible]. O[illegible] (A[illegible], 2011; A[illegible], 2001) [illegible]. W[illegible]. T[illegible].

[illegible] (ISI$_V$) [illegible] (ISI$_V$ [illegible] 50 [illegible]), [illegible] ISI$_V$ [illegible] 230 [illegible]; [illegible] F[illegible] 1A [illegible] 1B). W[illegible] ISI$_A$, [illegible] (ISI$_A$ [illegible]; S[illegible], 2010). S[illegible] C[illegible] & Vr[illegible], 2013). H[illegible] (see F[illegible] 1C; [illegible]

E[illegible] 1 [illegible]. I[illegible] E[illegible] 2, [illegible]. I[illegible] E[illegible] 3, [illegible] (E[illegible]) [illegible]. I[illegible] E[illegible] 4, [illegible] AM [illegible] GM [illegible]. A[illegible] E[illegible] 5 [illegible]. F[illegible] (Er[illegible] & B[illegible], 2002; R[illegible], 2006).

Materials and Method

Participants

A[illegible] 84 [illegible] (21, 22, 16, 12, 12 [illegible] E[illegible] 1–5; [illegible] 18–33 [illegible]) [illegible]. A[illegible]. T[illegible]. A[illegible] A[illegible] C[illegible] D[illegible] P[illegible], B[illegible], U[illegible] (#B[illegible] [2012-03-01]

. T 40 ISI$_V$, - . T . P 280 70 . A , . (D A M). T (PSE) , ISI 50% . T (JND), , (25%) (75%) .

Main experiments. I , , T 6 8 (T). A , T 30) (30-) (., ISI$_V$

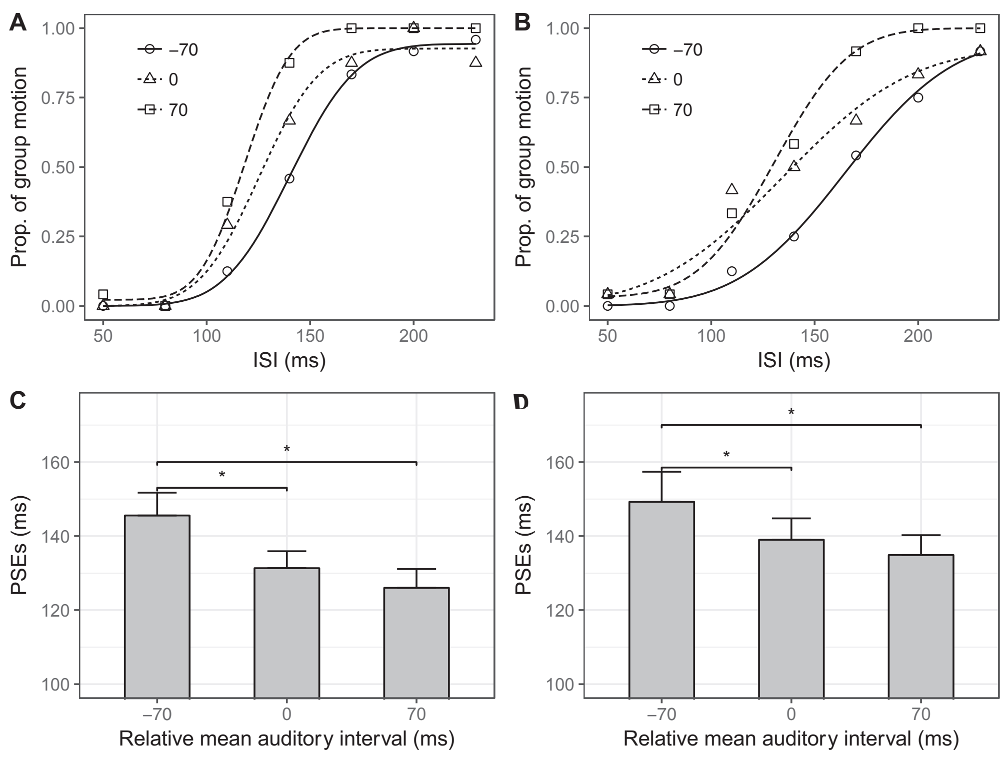
(-) T r r r r- , G . B r , r r T r r- (., σ) r G . T r B (B) R . O r r , r B r : :// . / r _ r .

Results

Experiments 1 and 2: Both Regular and Irregular Auditory Intervals Alter the Visual Motion Percept

W r (., ISI_A r r T r) r r r r, r AM r 70 r 70 r ( ) - r - (r r r ISI_A). A r r r , r r r r r r PSE (F 2), r r r , $F(2, 40) = 12.22$, $<$ .001, $\eta^2 = 0.112$, r r , $F(2, 42) = 8.25$, $<$ .001, $\eta^2 = 0.04$. T , r ( ) r r r r r r r r r. P B r- r r r r r r : 0.001, 0.00001, 0.57 r r : −70 r 0 , −70 r 70 , , 0 r 70 r r r ; 0.015, 0.0002, 0.77 r r r r (F 2C 2D).

T r r - r r r r r (J , M , M K , & P , 2002; L r & J , 1999). I ,



F 2. T r r r r r r . (A) R r r r : F r r , r r r - (ISI), r r , r r (r) r ; - r (−70, 0, 70) r r r , 70 r , 70 r r , . (B) I r r r : r r , r r r - r . (C) M (PSE) r r r r r r r . (D) M PSE r r r r r r r . * < .05.

. T . , F(1, 22) = 2.14, = .15. A (E 5).

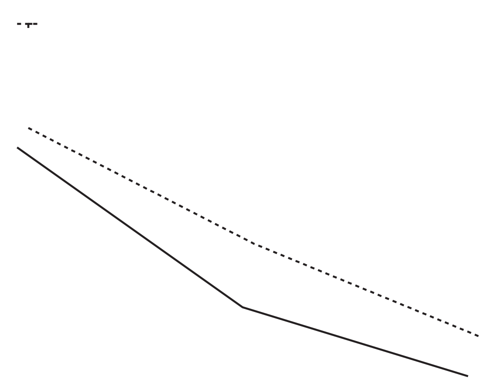
F JND (± E) ISI$_V$ (34.9 [±3.1], 30.5 [±3.4], 28.4 [±2.9] ISI$_V$ 70 70) JND ( ) (18.8 [±1.2] ; = .001, = .002, = .033), (>0.1). T : JND 31.8 (±3.2), = .001, 30.6 (±2.3), = .005, 27.2 (±2.2) 18.6 (±2.1) , (>0.1). T .

Experiment 3: Variability of Auditory Intervals Influences Visual Ternus Apparent Motion

A (Er & D L , 2011; S , C , & M 2013), . T . A ,

. T . T , AM. O (C , M & G , 1994; G , 1977), , W ' G , CV , S , CV (0.1) CV (0.3) ( ) : 50 , 50 .

T , F(2, 30) = 11.8, < .001, η^2 = 0.078, (., PSE : PSE 132 ± 4.6), (., PSE : PSE 147 ± 6.7), - (PSE 138 ± 5.3). P B E 1 2: (< .01) (< .001), (= .49). I , CV ( ), F(1, 15) = 5.29, < .05, η^2 = 0.044, CV , F(2, 30) = 0.31, = .73, η^2 = 0.0008 (F 3). F ( ) , F(1, 15) = 0.33, = .55.



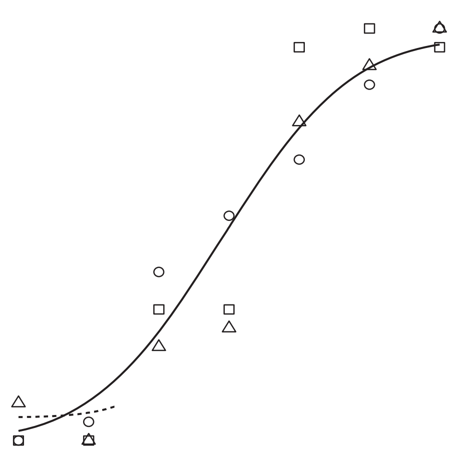
[illegible] B [illegible] M [illegible] (B [illegible], 1999; S [illegible] ., 2013), [illegible] F [illegible] 2 [illegible] CV [illegible] CV. T [illegible] B [illegible] M [illegible]. S [illegible] PSE [illegible] CV [illegible] AM [illegible] CV [illegible] GM [illegible] E [illegible] 4 [illegible] GM [illegible] AM.

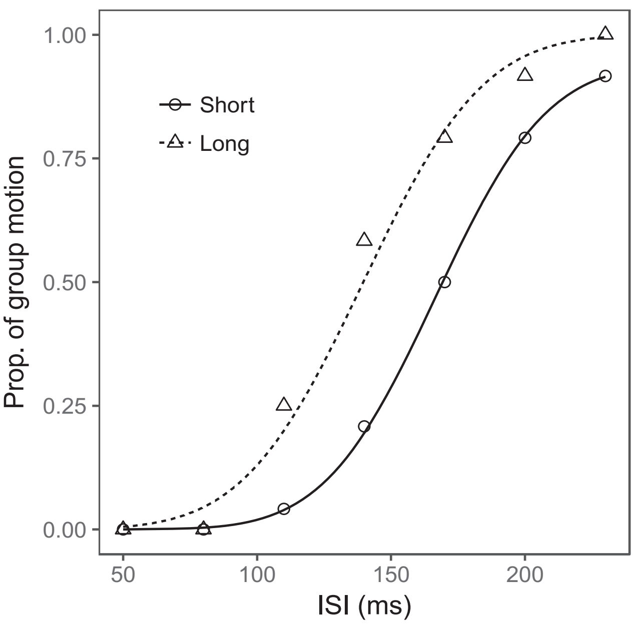
Experiment 4: Perceptual Averaging of Auditory Intervals Assimilates the Visual Interval Toward the GM Rather Than the AM

I E [illegible] 4, [illegible] Ar M [illegible] G M [illegible]. T [illegible] PSE [illegible] 136 (±5.46), 148 (±6.17), [illegible] 136 (±6.2) [illegible] Ar M, [illegible] G M, [illegible], $F(2, 22) = 8.81$, $< .05$, $\eta^2 = 0.08$ (F [illegible] 4). B [illegible] G M [illegible], $< .01$, [illegible] Ar M [illegible], $= 1$. T [illegible] GM [illegible] AM.

Experiment 5: Auditory Sequences With the Last Interval Fixed

I E [illegible] 1 [illegible] 3, [illegible] ([illegible]) [illegible]. I E [illegible] 5, [illegible] GM). F [illegible] 5 [illegible] E [illegible] 5. T [illegible] PSE [illegible] 153.1 (±7.3) [illegible], 137.9 (±9.1) [illegible], (11) = 3.640, $< .01$. T [illegible]. I [illegible] G [illegible].





F 5. M (ISI),

Bayesian Modeling

T B : B B . I (A) T (M) (MLE) (Er & B 2002), G): $A \sim N(I, \sigma)$, $M \sim N(I, \sigma)$

$$I = I + (1 -)I ,\tag{1}$$

= $(1\,\sigma^2)\,(1\,\sigma^2 + 1\,\sigma^2)$. N (K ., 2007; P , S , & Er ., 2012; R ., 2006). I 50 210). G (K 2007) T R (2006), P

$$P \sim {}^{-(I - I)^2 \sigma^2},\tag{2}$$

σ^2 . P T :

$$I = P\; I + (1 - P\;)I .\tag{3}$$

C E 1, E 3 :

$$I = (1 - P\;)I + P\; I .\tag{4}$$

T (E 1 3; E 4 5, T ; M M). G σ, σ σ σ , T L-BFGS R (:// / _). W (R^2) B (BIC). T BIC R^2 T 1. A BIC (K & R , 1995). T R^2 .

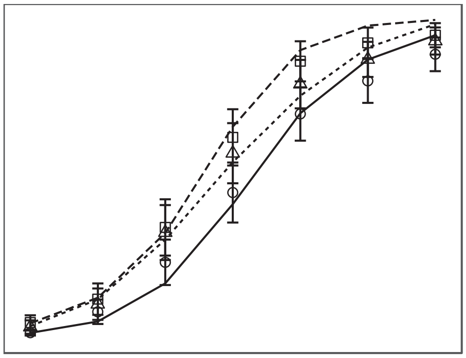
T ISI . F 6 . A (F 6).

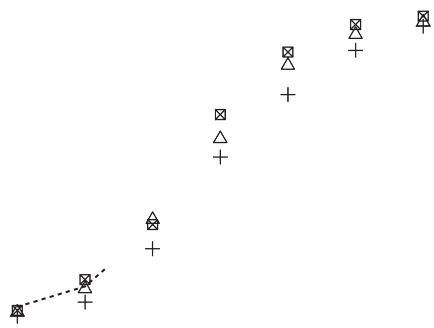
T ; , (., P) .

T 1
M C BIC R^2 P -F -I M

E	P BIC	P R^2	F BIC	F R^2	ΔBIC
I	−1,859	.86	−1,392	.63	**467**
R	−1,932	.91	−1,772	.88	**160**
V	−2,894	.91	−2,878	.91	**16**

N . T B (BIC) : ΔBIC >10). T BIC BIC .





T … F… 7, … A … F … 0 … 140 …, … (134.6 … 135.3 … 139.0 … 144.8 …). F … 70 …, … −70 …

B … PSE. F … 8 … PSE … L … 0.978 … R^2. T … 6% … E … 1 … 2 (… 1), … PSE. T …

… BIC … R^2 … (… T … 1). T …

General Discussion

U … T … W … (E … 1) … (E … 2 … 3) … T … I … E … 4, … GM … AM. F … (E … 5) …

Temporal Averaging and Geometric Encoding

Partial Integration in Cross-Modal Temporal Processing

Perceptual Averaging and Temporal Entrainment

Irrelevant Context in Multisensory Perceptual Averaging

(N , H , H , & S , 1992; N ., 2004), (B ., 2013).

Conclusion

I (S , 1964).

Context of the Research

GM

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R A 30, 2017
R M 16, 2018
A J 29, 2018 ■