Center of mass attracts attention

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Using the spatial cueing technique, this study demonstrates that the center of mass (centroid) of a visual scene has a special ability to attract attention even when there is no object presented at this location. Four boxes formed an imaginary square and were presented to the left or right hemifield. After the cueing in one box, a target appeared in one of the four boxes and, in addition, at centroid. Fastest reaction times were observed at centroid, irrespective of whether this centroid was also occupied by a box. Reaction times at the uncued locations varied according to their relative positions to centroid and fixation. No inhibition of return effect was observed when the cue was at centroid. *NeuroReport* 17:85–88 © 2006 Lippincott Williams & Wilkins.

Keywords: attention, centroid, inhibition of return, spatial cueing

Introduction

I a y ca c e f a a y, a e ca be a y ed e ce e f e a a y, e e a ee c e a e. Sa e b ec fea e e a f e d ay ca e a e [1 4]. By ea e effec f b f e (IOR) a a c e [5,6], e de a e a e ce e f a (ce d), c c ed f e e a b ec , a a a c a ab y a ac a e , e e e ee b ec e e ed a e ce e e f. T 'e y' ce e f c e a b e a, a y a ac a e ac a ace.

I de f a e , e ce e f a a f e d cc ed by by a eye f a . T e a ac f ce d a d a e a effec ce a e c f ded by b ec -ba ed a e [7,8] by e y e ed effec f f a , c a e a a e e d e e f a ca af e e ea ed f ca e by a a e e ea . Se e a d e, e e, e a e ce e f a a f e d a a ec a a eye e e , accade f e a d ea e 'ce e f a y' [9 17]. Ze y et al. [17], f e a e, e a ed f a a e a e ea c a a a a e f b ec . S y, a accade e e d ec ed a d e ce e f e ce e e e b ec e e a ea ed e e. T a e f e f a ce a a b ed e a e a f a a ac e ce e [16]. G e a a e f a d eye accade a e c e y c ed a d ay a e a c f c a e e b a [18 20], e ed c a e ce e f a y ay a f c a ec a ay a ac a e .

I fac , e dy a e a a e ec a e [21] e ed a ay deed be e ca e. T e a e ' e f a ce de ec a a e e e ed e e ec ed ef a f e d a e e e a e a acc a ed by d ac e e ed e a f e d a e a e e ed a e. If e a e a acc a ed by d ac e e e a e f e e ec ed e f e d, e e, e a e ' e f a ce ed. T f d e a d ac- e e ed e e ec ed e f e d a a y a ac a e a f e d a d f ce d f e a ay a d e e f, a ce d c e e a e. A ce d a ac a e , a e de ec fac a ed.

T dy e a e d ec y e e ce d a a ec a a a ac a e . T ac e e a , c c a e a a e e e a effec f ce e-ba ed a e f e effec , c a e d ced by eye f a . T e ef e, e b ec (b e) a e f c e f a a a y a e b e e ed e a e e e e ef e de f f a . T ea e e effec f ce d a e ba c f a , e ad a a e f e IOR effec a a c e [5,6], e e e c e a d a e a e a e d ffe e ca . T e IOR effec efe e f d a e e e a e a a ec ed ca a e e a e e e a e a a c ed ca f e e a y c y be ee e c e a d e a e e a 250 . I y e ed a a e , a ece y bee e ed f e e e y, b e e y b ed f e e e [5,6]. I dy, e d ffe e ce eac e (RT) e a e e e ed a c ed b e a d a ce d e e a e a ea e f e eff c e cy f a e a e . Ta e de ec d be e fa e e e e ed a ce d, f ce d ec a a ac a e .

Overview of the experiments

T e f e e e e e c d c ed, e (e e e 1A a d 1B) e f b e a c e e e e (e e e 2A a d 2B) ad a add a b a ce d. T e e f g e a e e e e e a e e b y a e e a y fa e RT a ce d e e e 1 e e beca e f e ac f a g c d g be ee e b a d e a g e a ca . T e ca f f a g a a a ed c a a e e e dd e be ee b e a e d e f e a f e d (F g. 1a) 2.9° a ay f dd e (F g. 1b). We y e ed a e e a g e e a e de cy f a e g bac f a af e e ea ed f ca e by e c e a a ca a ay f f a (.e. b C D). M g e f a g a ay f e dd e d a e e b ea f a (.e. b B) c e e a f a e e [22] a e d a g a b (e. g. b A). T , f RT e a g e e d a g a b e e fa e a RT e a g e e b ea f a , a y beca e e a g e e f e ca e ece ed e a e g e a ac f f a a e a g e e a e ca e.

G e a f a c d e e a g f e ce a e f ac ace, e d ffe e a ed e c ed ca e e e 1 y e , e ea f a (b e A a d B) a d e a ay f f a (b e C a d D). If a c ed b a ea f a , e a e f e d a g a b a a g a e y e ed a ac f f a ; f e c ed b a a ay f f a , e a e f e d a g a b a g e e a y c g e e a ac f a5g7I(a 8 2.8296.6 ,)-295.4( )-409.5(e (f a21(f)-655.4(634TD[(6.6( )- 89 ,)-295.4(e)-3.7(a284(

e f ed, e e e e a d f a d a ce, a e e ed F g. 2. A b ANOVA a f c d c ed f RT , e e e e a d f a d a ce a be ee - a c a fac a d c e ca a d a g e ca a - a c a fac .

A g y g f ca a effec f a g e ca [F(4,276)=124.59, P<0.001], a g e de ec c e a e c ed ca (357) a a e c ed ca (331, 328, 338 a d 316) a b e ed. T a e y ca IOR effec . I a y, e e ac be ee a g e ca a d c e ca a g f ca [F(4,276)= 30.08, P<0.001], g g e g a a e f c e g effec e e d ffe e f c e ea a ay f f a . Se a a e ANOVA e e e c d c ed f e y e f c e .

F c e ea f a , e a effec f a g e ca a g f ca [F(4,276)=77.44, P<0.001]. B fe -c - ec ed a e c a ed a e e a ea RT a e c ed ca (355) a g f ca y e (P<0.001) a RT a e c ed ca ea f a (325), e d a g a ca (333), e ca a ay f f a (342) a d ce d (315). I a y, c a be ee RT a e f c ed ca a ed g f ca d ffe e ce (P<0.001 P<0.005). T a e f c e g effec d d a y g f ca y e e e e e , a g e e ac be ee a g e ca- a d f a d a ce a a g a y g f ca [F(4,276)=2.28, 0.05<P<0.1].

F c e a ay f f a , e a effec f a g e ca a a g f ca [F(4,276)=125.18, P<0.001], e RT a e c ed ca (360) a a e c ed ca (P<0.001). F e a e e ed a , a e f c ed ca , RT a e ca ea f a (338) a d e ca a ay f f a (335) e e e a y fa (P>0.1). B f e , e e , e e e (P<0.001) a RT a e d a g a ca (323) a d a ce d (317). I a y, e d ffe e ce be ee RT a e a e ca a a g f ca (P<0.05).

A a y e f RT e a g e e e a c d c ed f c e a ce d e e e 2. A ecce c y effec a f d, RT a e ca a ay f f a (353) e a RT a ce d (344 , P<0.05) a e ca ea f a (340 , P<0.001). T e a e d d

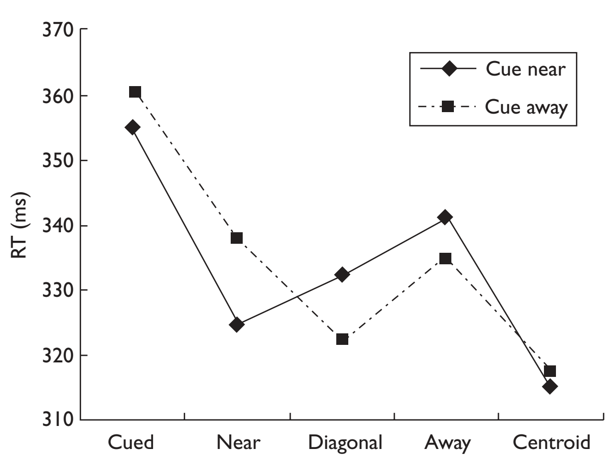

Fig. 2 Mean reaction times (RTs) (ms) collapsed over the four experiments.

d ffe f eac e (P>0.1). T , e e a IOR effec e e c e a a ce d.

Discussion

W e e c e a a e ca a ay f f a (e.g. b C F g. 1), a g e de ec a c ed ca ed a c ea ad a a g e f e d a g a ca a e ca ea f a a ay f f a (F g. 2). M e e , a g e de ec a ce d a e fa e c a ed a e ca . T a e f effec d d c a g e e ec e f a d a ce a d e e e ce ab e ce f a b ec a ce d. C ea y, e e effec ca be e a ed y by e d a ce be ee e c e a d e a g e be ee f a a d e a g e , a ca e a e d a ce c d a e d ffe e RT , a d ca e e a d g e d a ce c d a e e fa e RT . I ead, ey g g e a e ce d f a a f e d a a ec a ab y a ac g a e , fac a g e ce - g f e e ed e e. M e e , e a ac f ce d a d e a ac f f a e ac e e f f a e ac ace.

W e e c e a a e ca a ay f f a (e.g. b C F g. 1), a e a a a y ed by f ce af e a e ea ed f ca e by e c e: ce d a d eye f a . T e e f ce e e a g e y c g e a e d ec f e a e e a f e c e e e a . Ce d d ced e fa e RT e a g e , a d e ed d ce e ec d fa e RT a e d a g a b (e.g. b A). Eye f a c d a e a ayed a e a ac g a e a g e d ec . T e beca e a a e a RT e e fa e a e ca ea f a (e.g. b B) a a e ca a ay f f a (e.g. b D). T e fa e RT a e d a g a ca a a e ca ea f a a de a ed e effec f ce d, c a on e a f e c e e a g e . B ce d a d f a c d d ce e d f 'g a a a g– ', acce e a g a e e e f e c e e a g e f ce d f a ea e a , e e g a y f J e acce e a ed e eed f e acec af Ca ay Sa . T dea f 'g a a a g– ', e e , eed f e , de e - de e .

W e e c e a a e ca ea f a (e.g. b B), e a ac f ce d a d a ac f f a e e a g e y c g e , a , a g e a g e be ee e a f a e e f e c e ce d f a . T e fa e RT a ce d de a ed a g a e e g f ce d a ac g a e . T e ec d fa e RT e e a e ca ea f a (e.g. b A) a e a a e d a g a ca (e.g. b C), g g e g a e b f a a d ce d a e e e ec e a e e a , f a c d ay a g e e acce e a g a e e e .

T e f d g f IOR effec e e c e a a ce d c e e a g e a ce d ec a a ac g a e . I b e a , c a ed e ca , a e e ey d e e e a d/ e ca af e e c e g. T d ed ce e a e e b y effec .

A e y ce d d a e c a e e ad a a g e a ac g a e . T acc f e accad c da a c ce g ce d, c y a ed a g a g e a d g f accade , a

a f e bec e a e ed a d e eye
a y d ec ed c f a f bec a e a
d d a e [16,17]. T , e e e ea c d ay
ed a d e c a ed a a a e ce
a d e a e a f a a e ce d a c a y
a e . T e a e c e ay be a ed c e
a e . A e a e c d a ea e a bab y
e f e f e ca e e e f e d, e e bec
a d e e c e ed c d be e ce a y ed, a d
f a c e e c f a . A e a a f e e
ca ce d e a e cy a [24],
ca e a e . G e a a e bec
fea e are y ca y e ce e f e a f e d
f c e ec , a e d ce d a a e -
a a d b ca ad a a e, a e de e e f
IOR a e [5,6].

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References

1. J de J, Ya S. U e e f ab a e ca a e . Percept Psychophys 1988; 43:346 354.

1088;

Pediatr. Res ... 26505(9188)64.8(a e : f)6449.6(J17.(e)-2(eff e e)-684.9( )]TJ1.2519-198120T 0Tc7(a)4038.8(e)-34).9(a d)-333( )-J17.ff .