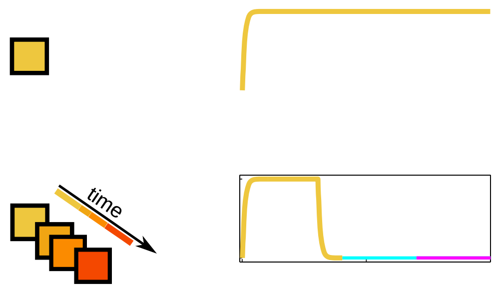
J C . . t Ne. ; ci (2015) 39:235 254
DOI 10.1007/ 10827-015-0574-4

2012). I. ;ta t , the te. ; a atte; f the ti. . . -

1 Va; iab e a d a; a. ete; ᵥᵥ ith thei; defa . t a . e

S . b	De c; i ti
Va; iab e	
I_j	E . te; a ti . . . f ; e .citat ; . ati j
u_j	N -di . e i a fi; i g; ate f e .citat ; . ati j (. a .i . . $u_j = 1$)
v	N -di . e i a fi; i g; ate f g ba i hibit ; . ati (. a .i . . $v = 1$)
p_j	Le e f faci itati f a e f; . . ati j (ba e i e $p_j = 1$)
w_{jk}, w	St; e gth f e .citati f; . . ati k t e .citat ; . ati j
T_j, T	D. ; ati f ti . . .
Ti . e a; a . ete; (defa . t a . e i a; e the i)	
τ	Ti . e ca e f e . ; a fi; i g (10 . [6])
τ_f	Ti . e ca e f h ; t te; . faci itati (1 [4])
τ_w	Ti . e ca e f ea; i g; . e (150 [1])
τ_a	Ti . e ca e f ada tati (400 . [5])
τ_s	Ti . e ca e f a tic i . t f; . the; . ati (50 . [6])
T_{cue}	D. ; ati f ti . . . t t; igge; ; e a (50 . [2,3])
D	De a i ; e a tic fi; i g affecti g c ecti betᵥᵥ ee . ati (30 . [1])
D'	De a i ; e a tic fi; i g affecti g c ecti ᵥᵥ ithi . ati (20 . [1])
Othe; a; a . ete; (defa . t a . e i a; e the i)	
ϕ	Fi; i g; ate ; e e f . cti (Hea i ide te f . cti)
θ	Th; e h d f ; acti ati f e .citat ; . ati (0.5)
θ_v	Th; e h d f ; acti ati f i hibit ; . ati (0.5)
p_{max}	Ma .i . . e e f h ; t te; . faci itati (2)
Z_k	St; e gth f e .citati f; . . ati k t i hibit ; . ati (0.3)
L	Weight f g ba i hibiti (0.6)
b	St; e gth f ada tati (1)
M	Lea; i g; . e th; e h d (1)
w_{max}	Ma .i . . a ticᵥᵥ eight betᵥᵥ ee . ati (0.4852)
w'_{max}	Ma .i . . a ticᵥᵥ eight ᵥᵥ ithi . ati (4.1312)
w_{min}	Mi i . . . a ticᵥᵥ eight ᵥᵥ ithi . ati (1.3488)
γ_d	St; e gth f LTD0 6.4598999 194.03999328 369.368985f h hh

a . . ti i. ified the a a i , b. t a t ece a:


time

2.

T g. a; a tee that g te; . a ticit ead t a ; e; e c di g f e e t ti. e , it i ece a; that the ea; ed w eight, w_{21}^{∞} gi e b E . (6), . atche the de i; ed w eight $\mathcal{W}(T)$ gi e b E . (9). Thi ca be achie ed b e . ati g the ; ight ha d ide f E . (6) a d (9), that

$(1$

(Ke . te; et a . 1999; Pfi te; a d Ge; t e; 2006; C ath et a . 2010).

T de. t;ate h the ti. i g f e e t ca be e c ded i the et ; a;chitect. ;e, e tat t ith t . ati (Fig. 2). D. ;i g t;ai i g, . ati 1 a ti. . ated f ; T_1 ec d f ed b ti. . ati f . ati 2 (Fig. 2a). The ti. . . a t; g e . gh t d . i ate the d a. - ic f the . ati ;e e (Secti 2). Whi e the fi; t ti. . . a ;e e t, . ati 1 a acti e a d LTD d . i ated, dec;ea i g the a tic eight, w_{21}, f; . . - ati 1 t . ati 2. Afte; T_1 ec d , the fi; t ti. . . e ded, a d the ec d . ati a acti ated. H e e;, . ati 1 did t bec . e i acti e i ta ta e . , a d f ; . e ti. e b th . ati 1 a d 2 e;e acti e. D. ;i g thi e; a i d , LTP d . i ated eadi g t a i c;ea e i a tic eight w_{21}. Sh ;t afte; . ati 1 beca. e i acti e, cha ge i the eight w_{21} cea ed, a a ticit cc. ; he the ;e a tic . ati i acti e. The i i- tia a d fi a a tic eight (w^0_{21} a d w^1_{21}, ;e ecti e) ca be c . . ted i c ed f ;. (Secti 2). Re eated ;e e tati f the t;ai i g e . e ce ead t e. e - tia c e;ge ce f the a tic eight , w^i_{21} (eight afte; ith t;ai i g t;ia), t a fi .ed a . e (Fig. 2b). O the the; ha d, the a tic eight w_{12} i ea e ed d. ;i g each t;ia beca. e the ;e a tic . ati 2 i a a acti e afte; the t a tic . ati 1 (Secti 2). I the ca e f N . ati , each eight $w_{k+1,k}$ i c e;ge t a e; a . e a ciated ith T_k, he;ea a the; eight i bec . e eg igib e d. ;i g ;e a . Th , the et ; t;. ct. ;e e e t a e c de the ;de; f the e . e ce.

The d. ;ati f acti ati i . ati 1, T_1, dete;. i e the e . i ib;i . a . e f the a tic eight f; . . a- ti 1 t . ati 2, w^∞_{21} (Secti 2). F ; a;ge; a . e f T_1, LTD a t ge;, ea e i g w_{21} (Fig. 2c). He ce,

; ed a . echa i . f ; ti. e- ee i g (B. . a 2000; D. ; te it 2003; Re. ti. a et a . 2004; Ka. a a a d B. . a 2007; Ga ; i et a . 2009). With . t . ch a ; ce , c. ed acti it . d ; e . t i a e . e ce ; e a ed i the ; e ; de, b. t i f ; . ati ab . t e e t ti. i g . d be t.

F ; i. icit e f c. t . ati , he e acti - it f the fi t . ati ; e ; e e t a ti. ed e e t (Fig. 3). T i. if the a a i , e a a . . ed that a tic eight a e fi . ed d. ; i g ; e a . Thi a . . ti i t e e tia (Secti 4.4). Afte . ati 1 i acti ated ith a b ief c. e, it ; e. ai acti e d. e t ; ec. ; ; e t e . citati (Secti 2

(. i g 20,000 i itia w^0). The a tic eight afte; the ith t; ai i g, w^i_{21}, i de c; ibed b a ; babi it de it f. c-ti that c e; ge i the i. it f . a t; ai i g t; ia . The ea (. de) f thi di t; ib. ti i the . t i e a . e f the ea; ed a tic eight afte; ; e eated ; e e tati f the e . e ce (Fig. 5c). The a; ia ce f the ea; ed a -tic eight, w^{∞}_{21},

a e ; a . ati , ca a the ; e f a w , ti e t ; ac - i g ; ce (Be da a d He ; 2003), i tead f h ; t te . faci itati . I c t ; a t t the ca e f h ; t te . faci itati , ada tati ca e the effecti e i . t f ; . e . ati t dec ; ea e e ; ti e.

I thi ca e . ati acti it w a . de ed b

$$\tau \frac{du_j}{dt} = -u_j + \phi(w_{jj}u_j + s_j - \theta - Lv - a_j),$$

$$\tau_a \frac{da_j}{dt} = -a_j + bu_j,$$

$$\tau_s \frac{ds_j}{dt} = -s_j + \sum_{k \neq j}^{N} w_{jk}u_k,$$

$$\tau \frac{dv}{dt} = -v + \phi\left(\sum_{k=1}^{N} Z_k u_k - \theta_v\right),$$

w he ; e a_j de te the ada tati e e f . ati j, τ_a i the ti e ca e f ada tati , a d b i the ada tati t ; e gth. Feedbac bet w ee . ati w a a . . ed t be w e ; tha feedbac w ithi a . ati ; th , the t ta i . t f ; . ati j w a it i t e f-e citati $(w_{jj}u_j)$, a d a tic i . t f ; . the ; . ati (s_j) w hich e ed the ti e ca e τ_s. N te that i the i it $\tau_s \to 0$, a e a ; e i ta ta e . .

F ; a . itab e ch ice f a ; a ete ; , g ba i hibiti t ; ac acti it fa te ; tha e citati bet w ee . ati . The , w he a . ati bec . e i acti e d e t ada - tati , the e e f g ba i hibiti dec ; ea e , a w i g . b e . e t . ati t bec . e acti e. Thi . ea the w eight f e f e citati ca e c de ti i g. Th , i thi et . w e . de ed g te ; . a ticit w ithi a . ati a w e . The ea ; i g ; . e f ; w_{jj} w a a a g . t w_{jk} w ith the additi a a . . ti that i ce w_{jj} ; e ; e e ted the a tic w eight w ithi a . ati , it c . d t dec ; ea e be w a ce ; tai a . e w_{min}. A , the a ; a ete ; f ; g te ; . a ticit w ithi a . ati a ; e a w ed t be dif- fe ; e t f ; . the a ; a ete ; f ; g te ; . a ticit bet w ee . ati .

The ea ; i g ; . e w a the

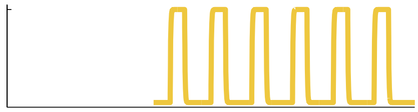
$$\tau_w \frac{dw_{jj}}{dt} = -\gamma_d'(w_{jj} - w_{min})u_j(t - D')(1 - u_j(t)) - \gamma_p'(w_{jj} - w_{max}')u_j(t - D')u_j(t).$$

Whe the . ati w a acti ated $(u_1(t) \approx 1)$ f ; $t \in [0, T_1]$ (Fig. 7a), the cha ge i the w eight w_{11} w e ; e g e ; ed b the iece w i e diffe ; e tia e . ati

$$\frac{dw_{11}}{dt} = \begin{cases} 0, & t \notin [D', T_1 + D'] \\ \frac{\gamma_p'}{\tau_w}(w_{max}' - w_{11}) & t \in [D', T_1] \\ -\frac{\gamma_d'}{\tau_w}(w_{11} - w_{min}) & t \in [T_1, T_1 + D']. \end{cases}$$

The f w i g e . ati ; e ate the a tic w eight at the e d f a ; e e tati , $w_{11}(T_{tot})$, t the a tic w eight at the begi i g f the ; e e tati , $w_{11}(0)$:

$$w_{11}(T_{tot}) = w_{11}(0)e^{-T_1\gamma_p'/\tau_w}e^{(\gamma_p'-\gamma_d')D'/\tau_w} + w_{max}'e^{-D'\gamma_d'/\tau_w}(1 - e^{-(T}$$



Thi ea; i g ; ce i di ti ct f; . the a ; ach . t i ed i (B. . a a d Maa 2009; He e . i et a . 2014), i ce it e t; ai the ; ec. ;; e t a; chitect. ; e bet ee - . ati e c di g ti. e; t. i g f a d t; ea. ; ead . t i . ece a; .

.4 f y2

The; e i a a; ge et f a; a. ete; f ; hich the et ; ca

t cc . ; . Thi a . . e the; e i . e e . te; a ig a i di-
cati g h ᵥ acc . ; ate the e . e ce i bei g ; e a ed. F ;
i ta ce, h . . a e; f ; . a ce f a iece f . . ic ; e ie

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