Supplementary Note

Optimal flash interval for CFS

An important parameter for successful CFS is the flash interval between successive presentations of distinct Mondrian patterns. We studied dominance during a one-minute observation period as a function of different flash intervals (**Fig. S1a** and **b**). The most effective flash interval for long suppression was between 80 and 320 ms (~3-12 Hz flash rate). We used a 10 Hz flash rate for all experiments reported here.

Total dominance duration and mean dominance period as a function of flash intervals

4 naïve subjects participated. During an one-minute observation period, a gray Gabor patch was presented to one eye while color Mondrian patterns at flash intervals ranging from 10 to 1280 ms or a stationary Mondrian (binocular rivalry or BR) were presented to the other eye in the same set-up as in **Fig 1**. Subjects pressed and held one of three keys to indicate their current percept: Mondrian only, Gabor only, and a mixture of the two. The flash interval was randomized within sessions. The measurement was repeated four times. Subjects took at least an one minute break between trials. In the analysis, 'Gabor only' and 'mix percept' was treated the same (Gabor visible) and contrasted against 'Mondrian only' percepts (Gabor invisible). The mean dominance period was calculated by excluding periods that were terminated by the end of the one minute observation interval.

Is CFS just a stronger version of BR?

Levelt's second proposition of binocular rivalry (BR) states that the stimulus strength of 'A' primarily determines the mean dominance durations (MD) of the stimulus 'B' presented to the other eye, with little effect on the MD of the stimulus A[1-4]. However, this rule does have exceptions[5-7]. If CFS is a straightforward extension of BR, one would expect the result of **Fig S1a**, with the dependence of the total dominance (TD) on the flash interval reflecting the 'effective stimulus strength' of Mondrian flashes. Because the frequency of reversal increases, the TD of the stimulus A increases, even though the MD of the stimulus A remains constant. Our analysis of TD (**Fig. S1a**) and MD (**Fig. S1b**) as a function of flash intervals shows that the extended TD of Mondrians is mainly due to the extended MD of Mondrian percepts. This is not what would be expected from a simple extrapolation of BR, in which a "strong" stimulus primarily reduces the MD of the rival stimulus (here the Gabor patch).

We propose a simple model assuming that the prolonged MD of Mondrians, which depends on the flash intervals, can be explained by the combined effect of BR and repetitive FS (**Fig. S1c** and **d**). Adding the FS component, whose sensitivity depends on the flash interval (**Fig. S2**), explains most of the variance of the data (**Fig. S1e** and **f**).

Simple model of BR

We started from a simple phenomenological model of BR[1]. During BR, the percept flips randomly between two interpretations with two statistical regularities: 1) Each period of dominance for a stimulus presented to one eye is well fit by a Gamma distribution and 2) each dominance period is dependent on the strength of the stimulus presented to the other eye. Levelt assumes a 4-th order Gamma distribution for the probability density functions:

$$f_{4,G}(t) = \frac{\lambda_M}{3!}(\lambda_M t)^3 \exp(-\lambda_M t), \quad (1)$$

$$f_{4,M}(t) = \frac{\lambda_G}{3!}(\lambda_G t)^3 \exp(-\lambda_G t), \quad (2)$$

where the subscripts G and M stand for the Gabor and Mondrian percept, respectively, and λ represents the stimulus strength. The mean duration of the Gamma distribution is inversely related to λ, such that $MD_G = \frac{4}{\lambda_M}$. As the MD for Gabor and Mondrian under BR are about 4 and 2 s (**Fig. S1b**), we chose $\lambda_G = 2, \lambda_M = 1$.

As in many rivalry situations[4], this model produces longer TD of Mondrian when the strength of Mondrian increases (**Fig. S1c**). However, the stronger the Mondrian stimulus (the larger λ_M values), the shorter the MD of Gabor (equation 1), without any effect on the MD of Mondrian (equation 2). As a result, we cannot reproduce TD and MD at the same time just by changing the strength of Mondrian. For example, we can approximate TD (**Fig. S1c**) but fail miserably for MD (**Fig. S1d**), with this minimal model. Clearly, the MD of Mondrian is independent of flash intervals (**Fig. S1d**), quite different from the actual inverse U-shape function we observe (**Fig. S1b**). For **Fig. S1c** and **d**, we set the strength of Mondrian as follows:

Flash interval (ms)	10	20	30	40	50	60	80	160	320	640	1280	BR
λ_M	1	1.5	2	2.5	3	3.5	4	6	6	2.5	1.5	1

Addition of a repetitive FS component

In standard FS, the success of suppression crucially depends on the length of pre-adaptation (See Wolfe, 1984[8], **Fig. 6**). Wolfe showed a monotonically increasing sigmoidal relationship between the pre-adaptation duration and successful FS.

We added a FS component to the above BR model. When the current percept is dominated by Mondrian patterns, each Mondrian flash 'refreshes' its percept with probability of $p(t_{FI})$ (t_{FI} is the flash interval). If the flash is successful, it resets the dominance period according to equation (2), maintaining the Mondrian percept. When the current percept is that of a Gabor, each Mondrian flash to the other eye flips the percept to a Mondrian at $p(t_{FI})$ after some refractory period. In the model, we used 2 s as a refractory period. This minimal addition explains most of the variance of TD and MD (**Fig. S1e** and **f**). $p(t_{FI})$ (**Fig. S2**) was derived to fit TD (**Fig. S1e**).

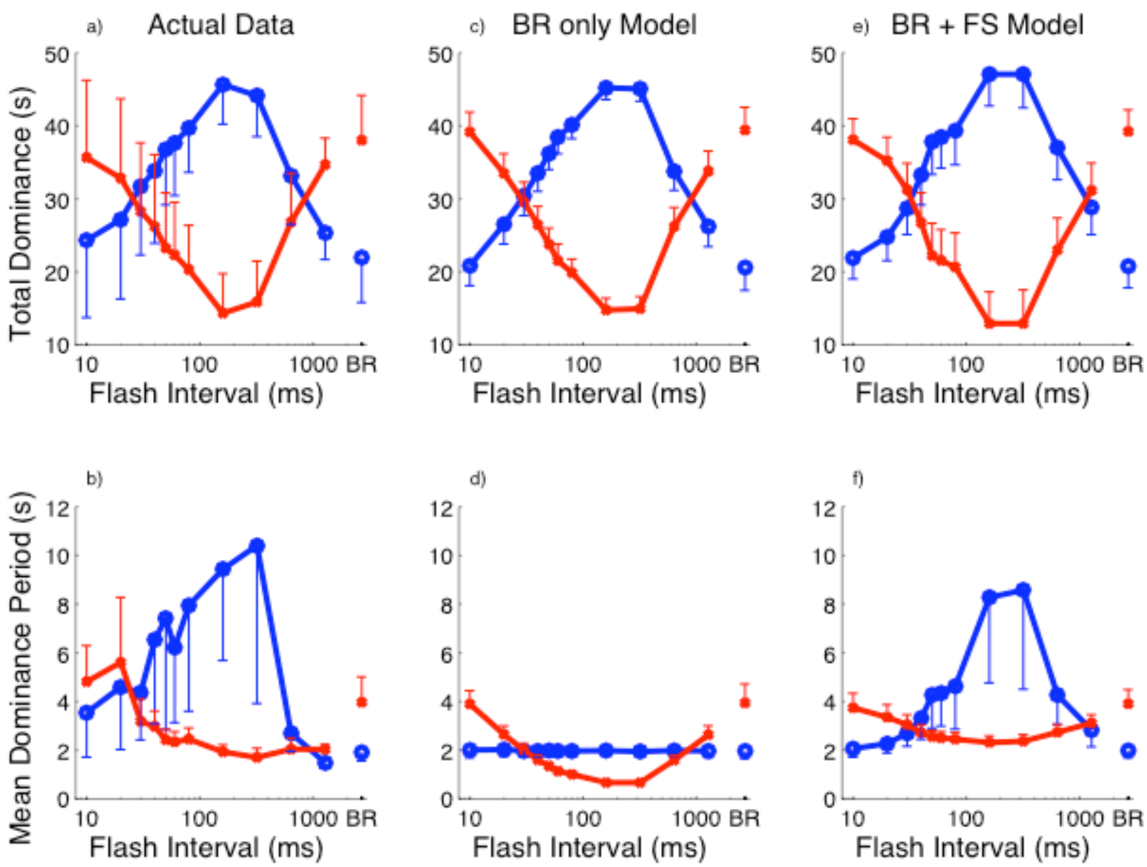

Figure S1. Optimal flash interval for continuous flash suppression. (**a,c,** and **e**) Total dominance duration (TD) and (**b, d,** and **f**) mean of each dominance period (MD) were plotted as a function of flash intervals. Error bars correspond to standard error. (**a** and **b**) Data from the actual experiment. Four subjects tracked the visibility of the Gabor patch during one-minute continuous viewing when any part of the Gabor pattern was visible (red) or invisible at all (blue). The right-most two points are for the case of binocular rivalry. (**c** and **d**) 200 simulated one-minute trials at each flash interval without a flash suppression component. The strength of the Mondrian was modulated to fit TD. (**e** and **f**) With the FS component, the peak of TD and MD is located around 80-320 ms flashed intervals. (200 simulated trials). The strength of the Mondrian stays constant but the probability of successful FS was fit to TD (**Fig.S2**). Without the FS component, these TD and MD curves cannot both be fitted simultaneously.

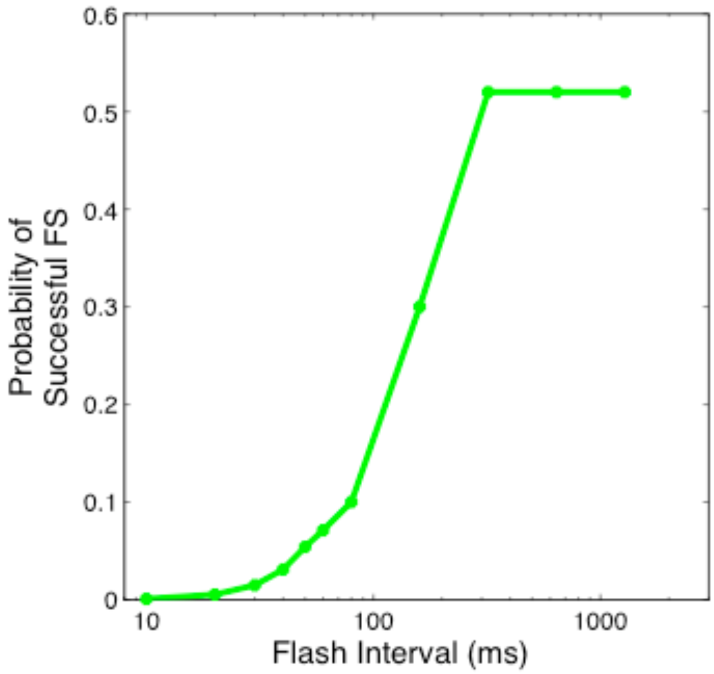

Figure S2. Probability of successful flash suppression as a function of the interflash interval. This monotonically increasing function was obtained by fitting the TD (**Fig. S1e**) for the actual data in **Fig. S1a**. Although the probability of suppression for each flash is low for small intervals, it accumulates.

Reference

1. Levelt, W.J.M. *On binocular rivalry*, (Institute for perception RVO-TNO, Soesterberg, The Netherlands, 1965).
2. Fox, R. & Rasche, F. Binocular rivalry and reciprocal inhibition. *Percept Psychophys* **5**, 215-217 (1969).
3. Blake, R. Threshold Conditions for Binocular Rivalry. *J Exp Psychol* **3**, 251-257 (1977).
4. Blake, R. & Logothetis, N.K. Visual competition. *Nat Rev Neurosci* **3**, 13-21 (2002).
5. Mueller, T.J. & Blake, R. A fresh look at the temporal dynamics of binocular rivalry. *Biol Cybern* **61**, 223-32 (1989).
6. Bossink, C.J., Stalmeier, P.F. & De Weert, C.M. A test of Levelt's second proposition for binocular rivalry. *Vision Res* **33**, 1413-9 (1993).
7. Sobel, K.V. & Blake, R. How context influences predominance during binocular rivalry. *Perception* **31**, 813-24 (2002).
8. Wolfe, J.M. Reversing ocular dominance and suppression in a single flash. *Vision Res* **24**, 471-8 (1984).