Additional Results -- Survival probabilities

As shown in Figure S1, we further examine how JA extends SA by calculating survival probabilities. The survival function is the conditional probability that a look will terminate in a given interval given the probability of its surviving to that interval. Figure S1 shows how long SA bouts lasted past a certain time by comparing survival probabilities between SA-with-JA and SA-without-JA. In the case of SA with the accompanying JA, because parents might join the child's look at different points in time after the start of the child's look, and longer bouts of sustained attention on the part of the child provide more time for parents to look to the same object, we only included instances that parents joined the child's look within a window of 3 seconds which is our definition of sustained attention. In this way, we can directly compare the potential effects of the parent's look on the child's sustained attention with those SA instances without parent look. Given that parents most often joined the child's look promptly after the onset of the child's look (lag_{mean}=1.93 sec, lag_{median}=1.34 sec), 81.86% of SA-with-JA instances are included in the analysis. To further examine whether the timing of joining has an effect, we divided those instances into three bins based on how far into the child's look that parents joined the look: 1) short: 0<lag<0.5 sec, 2) medium: 0.5 sec <lag<1 sec; and 3) long: 1 sec < lag < 3 sec. As a result, there were 33.75% instances in the short bin, 21.26% in the medium bin and 44.98% in the long bin. As shown in Figure S1, the three SA-with-JA cases survived longer than SA without JA. Moreover, there seems to be no effects of the timing that parents joined the child's look which is consistent with the findings in the main text.

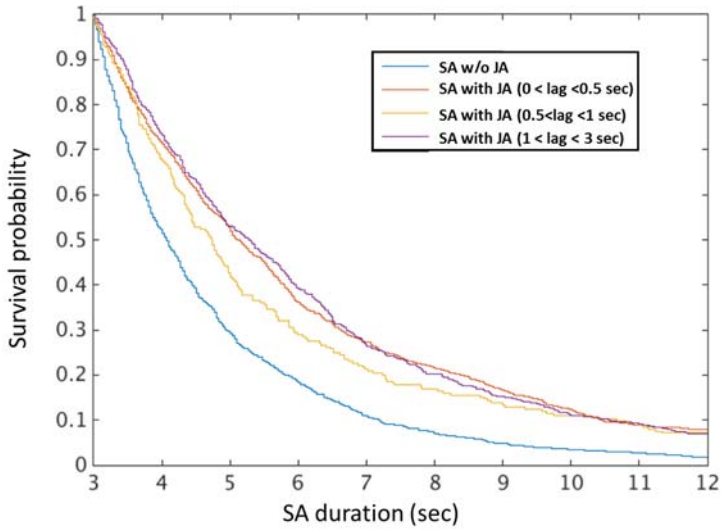

Figure S1. A comparison of survival probabilities that a look will terminate in a given interval given the probability of its surviving to that interval. SA-with-JA instances survived longer than SA alone.

Additional Results – Temporal Patterns between JA and SA

To provide a more complete picture of how JA supports and extends SA, we also divided all of the SA-with-JA instances into two groups of longer and shorter bouts (using the median as the dividing point) and then examined the durations of three periods – before the parent looked at the infant's object of interest, during the JA period, and after the parent stopped looking at the object. Consistent with the patterns reported above and as shown in Figure S2, we found that there was no difference between how fast parents joined the infant as a function of the length of the SA episode ($M_{long\text{-}SA}$=1620ms; $M_{short\text{-}SA}$ =1228ms, β=0.08, SE=0.27, n.s.). However, longer SA bouts were associated with longer joint attention bouts ($M_{long\text{-}SA}$=3112ms; $M_{short\text{-}SA}$ =2119ms, β=1.33, SE=0.12, p<0.001). Moreover, with longer infant attention to the object after the JA period ended, the infant continued looking at the target for 2071ms after the termination of parent look in the long SA cases, but only 541ms in the short SA cases (β=1.91, SE=0.23, p<0.001). Again, parent attention to an object to which the infant is associated with extended child interest to that object through the JA period and beyond that period.

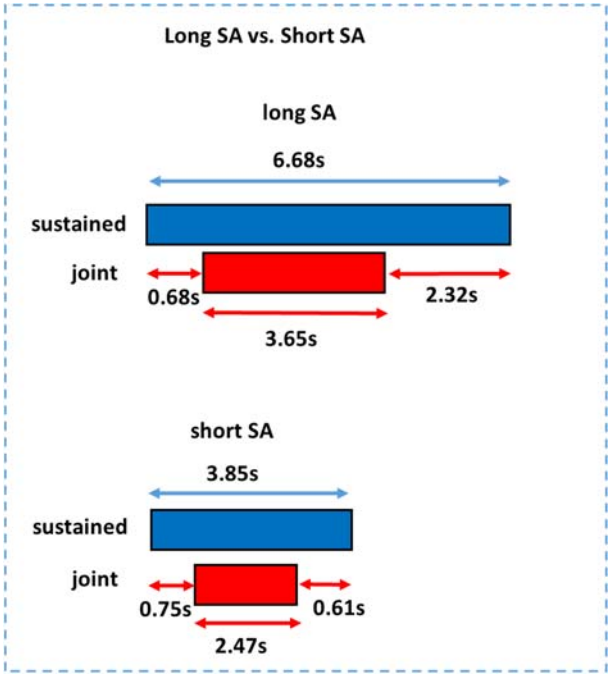

Figure S2. We divided all of the SA-with-JA instances into two groups of longer and shorter SA bouts and compared three critical periods defined by the temporal relation between JA and SA: before JA, during JA and after JA. The results further confirmed the findings reported in the main text, showing parent attention to an object to which the infant is associated with extended child interest to that object through the JA period and beyond that period.