ABSTRACT. Although powers of the Young-Jucys-Murphy elements $X_i = (1\,i) + (2\,i) + \cdots + (i-1\,i), \quad i = 1, \ldots, n$, in the symmetric group $\mathfrak{S}_n$ acting on $\{1, \ldots, n\}$ do not lie in the centre of the group algebra of $\mathfrak{S}_n$, we show that transitive powers, namely the sum of the contributions from elements that act transitively on $[n]$, are central. We determine the coefficients, which we call star factorization numbers, that occur in the resolution of transitive powers with respect to the class basis of the centre of $\mathfrak{S}_n$, and show that they have a polynomiality property. These centrality and polynomiality properties have seemingly unrelated consequences. First, they answer a question raised by Pak [**?**] about reduced decompositions; second, they explain and extend the beautiful symmetry result discovered by Irving and Rattan [**?**]; and thirdly, we relate the polynomiality to an existing polynomiality result for a class of double Hurwitz numbers associated with branched covers of the sphere, which therefore suggests that there may be an ELSV-type formula (see [**?**]) associated with the star factorization numbers.