We introduce a class of *Pólya sequences with dominant colors*, which can be described as randomly reinforced urn processes with color-specific random weights and unbounded number of possible colors. Let $\mathcal{D}$ be the set of colors for which the expected random reinforcement attains its maximum value; in this sense, we say that the colors in $\mathcal{D}$ are *dominant*. Under fairly mild conditions, we show that the predictive probability of observing a dominant color, $P_n(\mathcal{D})$, converges a.s. to one. Moreover, there exists a random probability measure $\tilde{P}$ with $\tilde{P}(\mathcal{D}) = 1$ such that the predictive and the empirical distributions converge weakly a.s. to $\tilde{P}$. The latter implies, in particular, that the urn process is asymptotically exchangeable with limit directing random measure $\tilde{P}$. In the general case, for any δ-neighborhood $\mathcal{D}_\delta$ of $\mathcal{D}$, the predictive probabilities $P_n(\mathcal{D}_\delta)$ and the empirical frequencies $\hat{P}_n(\mathcal{D}_\delta)$ converge a.s. to one. As a result, the distance between the observed color and $\mathcal{D}$ converges in probability to zero. We refine the above results with rates of convergence and central limit theorems. We further hint examples of the potential use of our model in randomized clinical trials and species sampling.