This thesis follows up mainly on the research of Drápal and Valent, who studied the nonassociativity of one quasigroup operation. Its central objective is to examine the number of triples $(x, y, z) \in Q^3$ such that $(x * y) \circ z = x * (y \circ z)$, where $(Q, *)$ and $(Q, \circ)$ are two quasigroups, $|Q| = n$. Let $a_2(C)$ be the number of such triples in a quasigroup couple C. Call it the associativity index. Denote by $a_2(n)$ the minimal $a_2(C)$, where C is a couple of order n. By averaging the associativity index over all the principal isotopes of a quasigroup couple, we prove that $a_2(n) \leq n^2(1+1/(n-1))$, $n > 2$. We then characterize the couples C that, on average, attain $a_2(C) = n^2$ and we prove that this value is an improved upper bound on $a_2(n)$, $n > 2$. Furthermore, we begin research on couples of quasigroups isotopic to groups. Lastly, we present computational results with examples, including $a_2(4) = 8$ and $a_2(5) = 9$.