Randomizing the 15 Puzzle

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PROJECT DESCRIPTION:

I plan on studying a modification of the 15 puzzle. If the game is played on a torus, a sixteenth tile can be added and moves can be made in a cyclic fashion shifting four of the tiles either horizontally or vertically. The question is if each of the sixteen moves is made with probability 1/16, how many of these random moves would it take to randomize the whole puzzle: to have each of the possible configurations be essentially equally likely.

I have taken abstract algebra and probability, which have hopefully given me a base of knowledge for beginning this research. I have also read parts of the chapters in *Group Representations in Probability and Statistics*, by Persi Diaconis, on random walks on groups and probabilistic arguments. Diaconis presents the problem as an open problem and states that it is known that it takes order n^3 moves to randomize a single square and he believes it would take order $n^3 \log n$ to randomize the entire puzzle (in the generalized nxn case).