proof of Frattini argument

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Let $g \in G$ be any element. Since H is normal, $gSg^{-1} \subset H$. Since S is a Sylow subgroup of H, $gSg^{-1} = hSh^{-1}$ for some $h \in H$, by Sylow's theorems. Thus $n = h^{-1}g$ normalizes S, and so $g = hn$ for $h \in H$ and $n \in N_G(S)$.