In Short
Escalation is not a product of inadequately updated or irrational beliefs. Moreover, contrary to Jervis, it is not necessary to hold extreme beliefs about the intentions of the other state to see its buildup as escalation. Escalation occurs when a state believes there is the slightest possibility that its adversary is not fearful (that is, its adversary does not believe that the first state is preparing to attack). It is possible for security-seeking states to avoid getting into spiraling arms races with each other by refraining from arms buildup.

Central Question(s)
If a state makes a security-enhancing move out of concern for its own security, and out of fear of another state, why might it assume that the other state's reaction is a sign of aggression (alternatively)? If states realize that the cycle of action-reaction is leading them to a war that neither party desires, why do they not find some way of ending the escalation (alternatively, when can they break the cycle)?

Central Hypotheses
Greedy states are more likely than security-seeking states to build up for the purposes of expansion, independent of the type of adversary that they think they have, whereas security-seeking states will only build up if they believe that their adversaries are greedy. Security-seeking states can break the security dilemma by signaling their benign intentions. Greedy states will not be willing to signal non-aggressive intentions, and are more likely to end up fighting a war. If the cost of war and/or being involved in an arms race are low, then it will be difficult to break out of a security dilemma. Also, stronger states will be less willing that weaker ones to signal their way out of a security dilemma, because weaker states have more of an incentive to avoid war.

How He Makes His Argument
In Kydd's game, there are four possible types of players, varying along two axes. The first axis is the level of aggression, or greed. The second variable is the level of fear the state has of the adversary, that is, how likely a state thinks it is that its adversary is greedy. There is a given likelihood that each state is greedy that is communicated by messages from Nature, and each state makes an estimation as to its adversary's level of greed. Additionally, each state estimates how likely it is that its adversary believes that it (the former state) is greedy. Based on this knowledge (what Kydd refers to as the information structure), there are two rounds of decision-making. In the first, a state can attack another player or defend itself. If both sides defend, there is obviously no war, and the second round of decision-making kicks in. States can either build up their weapons stock, or wait to do so. They subsequently face another attack/defend decision. The payoffs of each decision depend upon the type of state. For a security-seeker, peace without arms buildup has the highest payoff. The lowest payoff for any state is fighting a war that is subsequently lost.

After describing the structure of the game, Kydd embarks on an analysis of its implications. First of all, there are many equilibria. He ignores those that involve a high degree of certainty (independent of each state's type)—what he calls "mild" conditions, as well as "harsh" conditions, where there is a significant first-strike advantage and each side is already almost completely convinced that the other side will attack first. In neither case will a spiral develop. Kydd is most interested in the equilibria which involve learning and changes in belief, which would occur after moves in the first round. If in the first round all states choose to defend, three types of states—the greedy fearful and greedy trusting, as well as the security-seeking fearful, will build up arms after the first round. A state observing buildup cannot tell what the building up state's nature is on the basis of its first round action (this is assuming, of course, that the nature of its buildup does not send additional signals). However, this does send dyads of security-seeking fearful states into a spiral of escalation that leads to war between them. An alternate equilibrium has all security-seeking states refraining from buildup after the first round, in which case, security-seeking states reassure each other about the other's intentions. This requires the greedy state to be just greedy enough that it would not mimic security-seeking behavior.

Kydd believes that his model illustrates the mechanism through which Jervis' security dilemma works, but that he goes just a little bit farther than Jervis. A state may be fearful, but if it believes that its adversary may be trusting (that is, not fearful), then a buildup will be seen as escalation. Kydd argues that security seekers are actually more readily provoked than are greedy states—greedy states are more likely to believe that an escalation was motivated by fear than are security seekers. As an arms race progresses, a state is more likely to believe that its adversary is fearful (I'm not sure how the adversary's sustained forbearance where attacking is concerned is built into the logic here). Kydd believes that his model illustrates how hawks and doves can rationally interpret another state's behavior in different lights, and both find evidence to support their claims—the observed state may appear to be more likely to be aggressive than fearful, and also more fearful. Taking up his second question (how states break out of cycles of escalation), Kydd believes that there is a range of fearfulness within which states will refrain from building not merely because of domestic costs, but because they recognize the costs of provoking an adversary. He is more specific now about the value conferred by particular military weapons, saying that the more valuable the weapons are, the lower the threshold of fear at which a state will be willing to forego them as a signaling tactic. The greater a state's chance of victory, the lower the threshold of fear at which it will be willing to signal good intentions will be. This is actually your simple "weaker states have a greater incentive to avoid war than do more powerful states" argument.

Kydd has made his argument without resorting to an offense/defense distinction. Moreover, he argues that you do not need a world of extreme or prejudiced belief to find escalation and de-escalation. Rather, upward and downward spirals can be a product of perfectly rational calculation and learning.