If the agent's policy π is **stochastic**, the agent selects action a with probability $\pi(a|s)$ when in state s, and the Bellman Expectation Equation can be rewritten as the sum over three variables (s', r, and a):

$$v_\pi(s) = \sum_{s' \in \mathcal{S}^+, r \in \mathcal{R}, a \in \mathcal{A}(s)} \pi(a|s)p(s', r|s, a)(r + \gamma v_\pi(s'))$$

In this case, we multiply the sum of the reward and discounted value of the next state $(r + \gamma v_\pi(s'))$ by its corresponding probability $\pi(a|s)p(s', r|s, a)$ and sum over all possibilities to yield the expected value.

There are 3 more Bellman Equations!

In this video, you learned about one Bellman equation, but there are 3 more, for a total of 4 Bellman equations.

> *All of the Bellman equations attest to the fact that value functions satisfy recursive relationships.*

For instance, the **Bellman Expectation Equation (for v_π)** shows that it is possible to relate the value of a state to the values of all of its possible successor states.

After finishing this lesson, you are encouraged to read about the remaining three Bellman equations in sections 3.5 and 3.6 of the textbook. The Bellman equations are incredibly useful to the theory of MDPs.