



Figure 16.8: All of the kinds of active paths of length two that can exist between random variables a and b . (a) Any path with arrows proceeding directly from a to b or vice versa. This kind of path becomes blocked if s is observed. We have already seen this kind of path in the relay race example. (b) a and b are connected by a *common cause* s . For example, suppose s is a variable indicating whether or not there is a hurricane and a and b measure the wind speed at two different nearby weather monitoring outposts. If we observe very high winds at station a , we might expect to also see high winds at b . This kind of path can be blocked by observing s . If we already know there is a hurricane, we expect to see high winds at b , regardless of what is observed at a . A lower than expected wind at a (for a hurricane) would not change our expectation of winds at b (knowing there is a hurricane). However, if s is not observed, then a and b are dependent, i.e., the path is active. (c) a and b are both parents of s . This is called a **V-structure** or **the collider case**. The V-structure causes a and b to be related by the **explaining away effect**. In this case, the path is actually active when s is observed. For example, suppose s is a variable indicating that your colleague is not at work. The variable a represents her being sick, while b represents her being on vacation. If you observe that she is not at work, you can presume she is probably sick or on vacation, but it is not especially likely that both have happened at the same time. If you find out that she is on vacation, this fact is sufficient to *explain* her absence. You can infer that she is probably not also sick. (d) The explaining away effect happens even if any descendant of s is observed! For example, suppose that c is a variable representing whether you have received a report from your colleague. If you notice that you have not received the report, this increases your estimate of the probability that she is not at work today, which in turn makes it more likely that she is either sick or on vacation. The only way to block a path through a V-structure is to observe none of the descendants of the shared child.