**Ravens At Play:**

**The Social and Developmental Implications of Item-Caching Behavior**

Ravens hide items and food in the wild and captivity, a behavior referred to as caching (Jacobs et al., 2014). Often, this behavior occurs near conspecifics, similar to other forms of social play (Heinrich & Pepper, 1998; Jacobs et al., 2014). Item caching is theorized to help ravens practice caching strategies using low-risk items and learn which conspecifics are prone to thievery (Bugnyar et al., 2007; Heinrich & Pepper, 1998). This review will examine the importance of raven item caching in developing the social and foraging skills required to compete with conspecifics (Bond & Diamond, 2003).

Caching behavior requires well-developed spatial awareness and mid-to-long-term memory recall (Kaplan, 2020). Bugnyar studied how these prerequisite skills for caching develop in ravens (Bugnyar et al., 2007). To study the development of caching in different life stages, Bugnyar and Stöwe gave captive juvenile ravens items to cache (Bugnyar et al., 2007). They monitored cache complexity from chick to sub-adulthood. In these ravens, complex caching developed alongside object permanence (Bugnyar et al., 2007). Multiple experiments demonstrated that object permanence and caching complexity develop in stages, beginning with little awareness of a hidden object and minimal hiding (level one), and progressing to the ability to find an object which has been moved and re-hidden outside of view, or camouflaging an object out of view of conspecifics (level five) (Bugnyar et al., 2007; Miller et al., 2015). Bugnyar and Stöwe noted that when the ravens watched items being hidden, their ability to find the objects behind complex camouflage coincided with the ravens exhibiting sophisticated caching behaviors as they matured (Bugnyar et al., 2007). Bugnyar and Stöwe also noted that level five awareness developed pre-independence and hypothesized that object permanence and caching behavior play a role in post-independence survival (Bugnyar et al., 2007).

Early exploration is vital in developing foraging strategies, including item caching. Two independent experiments exposed captive juvenile ravens to new objects and situations from youth to adulthood (Bugnyar et al., 2007; Miller et al., 2015). In both cases, juvenile ravens interacted most but lost interest after repeated exposure to novel items (Miller et al., 2015; Stöwe et al., 2006). Stöwe observed in his corvids that juveniles were more willing to explore; neophobia[[1]](#footnote-1) developed around sub-adulthood, after the individual learned the required skills for independence (Stöwe et al., 2006). In adulthood, the ravens used more camouflaging techniques caching food than items (Bugnyar et al., 2007). Stöwe hypothesized that the ravens’ neophilic[[2]](#footnote-2) juvenile period allowed for the development of caching and camouflaging, and helped the ravens learn to exploit new environments (Stöwe et al., 2006). Heinrich and Jacobs independently hypothesized that a neophobic[[3]](#footnote-3) young raven would face difficulties developing new skills due to nervousness towards new situations (Heinrich, 2011; Jacobs et al., 2014).

Since the requirements for complex memory develop alongside complex caching in ravens, researchers began to study why ravens bother caching non-food items. Curious if ravens adjusted their behavior in response to pilfering conspecifics, Bugnyar offered captive ravens objects to cache, then sent volunteers to either observe the object without displacing it, or remove it (Bugnyar et al., 2007). Then, they watched the ravens respond to the same volunteers approaching food caches. Bugnyar observed the ravens defending food caches more in the presence of the ‘thief’ volunteer than the volunteer who left the object alone (Bugnyar et al., 2007). Researchers performing similar experiments theorized that item caching helps juvenile ravens learn which conspecifics might threaten their food caches (Bugnyar et al., 2007; Heinrich & Pepper, 1998). They concluded independently that the ravens learned which conspecifics would pilfer by observing their behavior near item caches and applied this knowledge in future situations (Bugnyar et al., 2007; Heinrich & Pepper, 1998).

 The possible hormonal triggers of item caching behavior in ravens are unknown and could inspire further research. Another area of research would be to study the impact of a lack of item-caching opportunities on social and foraging skills. This information would inform the rehabilitation of young ravens by explaining how the skill develops and its importance post-release.

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1. Neophobia: Fear of novel situations. [↑](#footnote-ref-1)
2. Neophilia: The tendency to approach novel situations. [↑](#footnote-ref-2)
3. [↑](#footnote-ref-3)