

Study Guide for Canine Social Cognition and Human-Dog Interactions

Quiz: Short-Answer Questions

Answer each question in 2-3 sentences, based on the information provided in the source documents.

1. According to the fMRI study by Berns et al., how did the canine brain's reward center respond to various biological odors, and what does this suggest about the dog-human relationship?
2. What is the "correlated by-product" hypothesis for the evolution of dog social cognition as described by Hare et al., and how did the experiment with selectively bred foxes support this hypothesis?
3. The review by Albuquerque and Resende discusses a "functional perspective" on emotion perception. What does this perspective propose about how dogs use emotional information from humans?
4. What anatomical difference in facial musculature did Kaminski et al. discover between domestic dogs and wolves, and what is the behavioral significance of this muscle?
5. The study by vonHoldt et al. links canine hypersociability to genes associated with what human neurodevelopmental disorder, and which two specific genes were implicated?
6. In the study on university students by Thelwell, how did the psychological outcomes of directly interacting with a dog compare to those of watching a video of a dog?
7. What were the overall findings of the Marshall-Pescini et al. study regarding the effect of socio-positive interactions on urinary oxytocin (OT) levels in dogs and their owners?
8. According to Gee et al., what are the three core components of the biopsychosocial model, and how does this framework help explain the effects of dogs on human health?
9. The study by vonHoldt et al. measured three behavioral indices relevant to Williams-Beuren Syndrome. Name these three indices and briefly describe what they quantify.
10. In the Berns et al. study, the olfactory bulb/peduncle and the caudate nucleus showed distinctly different patterns of activation to the five scents presented. Describe this difference.

Answer Key

1. The study found that the caudate nucleus, a brain region associated with positive expectations and reward, was activated maximally to the scent of the familiar human. This suggests that dogs have a strong positive association with humans, which is processed as a rewarding stimulus even in the person's absence.
2. The "correlated by-product" hypothesis suggests that dogs' ability to read human communicative gestures was not directly selected for, but instead evolved as a by-product of selection for tame behaviors (against fear and aggression). The study supported this by showing that fox kits experimentally domesticated for tameness were as skilled as dog puppies in using human gestures, despite never being selected for this specific cognitive ability.

3. The functional perspective proposes that dogs do more than just perceive human emotional expressions; they use this information to solve problems and make decisions that increase their fitness and success in social situations. This means acquiring information from human faces and body postures allows them to adjust their own behavior and anticipate the future behavior of others.
4. Kaminski et al. found that the *levator anguli oculi medialis* (LAOM) muscle, which is responsible for raising the inner eyebrow (the "puppy dog eyes" expression, or AU101), is uniformly present in dogs but not in wolves. This movement makes the eyes appear larger and more infant-like, potentially triggering a nurturing response from humans and giving dogs a selective advantage.
5. The study links canine hypersociability to genes associated with Williams-Beuren syndrome (WBS) in humans. Structural variants in the genes *GTF2I* and *GTF2IRD1* were found to contribute to the extreme sociability observed in dogs.
6. While all participants experienced a reduction in anxiety and an improvement in mood, those who directly interacted with the dog experienced a significantly greater decline in anxiety and improved mood scores. Specifically, direct interaction led to greater increases in joviality and greater decreases in sadness and anxiety compared to watching the video.
7. The study was unable to show that a socio-positive interaction with either a bonded or familiar partner significantly increased peripheral oxytocin levels in either dogs or their owners. The results were puzzling and contrasted with some previous studies, leading the authors to suggest that the role of OT in the dog-human relationship may be overrated or that methodological inconsistencies across studies are a significant issue.
8. The three components are biological (e.g., physiological changes like blood pressure, cortisol), psychological (e.g., mood, emotions, cognition), and social (e.g., social relationships, support networks). The model helps explain how an interaction with a dog can influence one realm (e.g., a biological reduction in stress) which in turn influences the other realms (e.g., psychological improvement in mood and social increase in interaction).
9. The three indices were Attentional Bias to Social stimuli (ABS), which quantified the proportion of a dog's attention directed toward an experimenter versus a puzzle box; Hypersociability (HYP), which quantified engagement with humans across different social scenarios; and Social Interest in Strangers (SIS), which quantified engagement with an unfamiliar person.
10. The olfactory bulb/peduncle was activated to a similar degree by all five scents (self, familiar human, strange human, familiar dog, strange dog), indicating that the scents were being processed. In contrast, the caudate nucleus showed a significant difference between scents, with a maximal response to the familiar human, indicating a unique and positive association with that specific scent.

Essay Questions

1. Analyze the role of domestication in shaping canine social cognition and anatomy. Synthesize evidence from the experimental fox study (Hare et al.), the genetic analysis of hypersociability (vonHoldt et al.), and the study of facial musculature (Kaminski et al.)

to build a comprehensive argument about the evolutionary pressures that created the modern dog.

2. Critically evaluate the evidence for the physiological effects of human-dog interactions, focusing on the roles of cortisol and oxytocin. Discuss the findings from the studies by Gee et al., Marshall-Pescini et al., and Polheber & Matchock (cited in Gee et al.), addressing the mixed results, methodological challenges, and theoretical implications for understanding the biological basis of the human-animal bond.
3. Using the biopsychosocial model (Gee et al.) as a framework, explain how interacting with a dog can improve the well-being of university students, as demonstrated in the study by Thelwell. Discuss how specific outcomes like reduced anxiety and improved mood can be understood as an interplay between biological, psychological, and social factors.
4. Discuss the concept of dogs having a "functional understanding" of human emotional and communicative cues. Integrate findings from the fMRI odor study (Berns et al.), the review on emotion perception (Albuquerque & Resende), and studies on dogs' sensitivity to human gestures (Hare et al., vonHoldt et al.) to explain how dogs process and use human-generated social information.
5. Compare and contrast the two primary hypotheses for the evolution of dog social cognition: the "selection for communication" hypothesis and the "correlated by-product" hypothesis. Use evidence from the provided source texts to argue which hypothesis is better supported and why.

Glossary of Key Terms

Term, Definition

Animal-Assisted Interventions (AAI), The inclusion of animals in therapeutic and educational settings as an adjunct or complementary therapy to improve some aspect of human health and well-being.

AU101 (Inner Eyebrow Raise), "A specific facial muscle movement around the eyes, produced by the LAOM muscle, that makes the eyes appear bigger and more infant-like. Its production in dogs is linked to eliciting a nurturing response from humans."

Biopsychosocial Model, "A theoretical framework used to conceptualize how biological (physiological changes), psychological (mood, emotions), and social (relationships, culture) influences combine to determine human health and well-being."

Caudate Nucleus, "A brain region well-known for its association with positive expectations, reward processing, and social rewards."

Conspecifics, Members of the same species.

Correlated By-Product Hypothesis, "A hypothesis suggesting that the ability of dogs to read human communicative gestures was not a direct target of selection, but rather evolved as a correlated by-product of selection for tame behaviors (against fear and aggression)."

fMRI (Functional Magnetic Resonance Imaging), "A neuroimaging technique used to measure brain activity by detecting changes associated with blood flow. In the Berns et al. study, it was used to measure brain responses in awake, unrestrained dogs."

GTF2I and GTF2IRD1, Two genes from the transcription factor II-I (TFII-I) family implicated in the hypersocial behavior of individuals with Williams-Beuren syndrome. Structural variants in these genes are also associated with extreme sociability in domestic dogs.

Heterospecifics, Members of different species.

Hypersociability, "An exaggerated gregariousness and a heightened propensity to initiate social contact, often extended to members of another species. It is a core element of domestication that distinguishes dogs from wolves."

Levator anguli oculi medialis (LAOM), A facial muscle responsible for raising the inner eyebrow intensely (producing the AU101 movement). The study by Kaminski et al. found this muscle is uniformly present in dogs but not in wolves.

Olfaction, "The sense of smell, believed to be a dog's most powerful and important sense."

Oxytocin (OT), "A neuropeptide involved in multiple social bonds, such as attachment between parents and offspring, and has been hypothesized to play a key role in the dog-human relationship, for example in an "oxytocin-gaze positive loop.""

Paedomorphism, "The retention of juvenile-like physical features in adults. In dogs, this can include a large forehead and large eyes, features that humans tend to find appealing."

PANAS-X (Positive and Negative Affect Schedule-Expanded Form), "A self-report measure involving words and phrases that describe different feelings and emotions, used to assess a person's mood."

Region of Interest (ROI) Analysis, "An fMRI analysis method focusing on specific, predefined brain regions (like the olfactory bulb or caudate nucleus) to test hypotheses about their function, which increases statistical efficiency."

Selection for Communication Hypothesis, A hypothesis suggesting that the ability to predict and manipulate human behavior by reading communicative signals (like gestures) was a direct target of selection during dog domestication.

Social Referencing, "The process of using social cues from another individual when facing novel stimuli to guide one's own behavior, serving as a source of approach or avoidance information."

STAI (State-Trait Anxiety Inventory), "A self-report measure including statements rated on a Likert scale to assess how a person feels in the moment, specifically regarding their level of anxiety."

Structural Variants (SVs), "Alterations in the structure of an organism's chromosome, such as deletions, insertions, duplications, and transpositions. SVs in specific genes on chromosome 6 are linked to hypersociability in dogs."

Williams-Beuren Syndrome (WBS), "A human multisystem congenital disorder caused by a deletion of a specific region on chromosome 7, characterized by hypersocial behavior, delayed development, and cognitive impairment."