Turning off dogs’ brains: roles for reactivity and exposure in problem solving behavior

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Problem-solving ability and ‘cognition’

• I: Assess K-9 problem-solving ability using novel tasks/techniques that differ from those used to select and train working dogs to develop an external referent about ability and skill set.

• II: Assess an “equivalent” population of pet dogs, and include an auditory assessment and further testing of young dogs, older dogs, test-retest, and testing over time (repeated measures).
Overall cognitive performance

Domain 1: *Social learning*

Domain 2: *Spatial learning/memory*

Domain 3: *Executive function: sustained attention, perseverance, inhibition*

Domain 4: *Spontaneous behavior: laterality, response to stressor*

*Cognitive domains in dogs* (sensu Lezak et al., 2004; Strauss et al., 2006; Gabowitz et al., 2008)
THE CITP
Study features

• CITP (Canine Intelligence Test Protocol)
• WDQ-PET (includes AIR/SAIR scores)
• Awake auditory evaluation of a subgroup of noise reactive/phobic dogs
  – Of 35 dogs available for hearing tests over 6 weeks, 19 dogs were noise reactive/phobic, 16 were non-reactive.
• VOYCE band measurement of movement in 3 dimensions every second (custom firmware) and calculation of deviations and extremes
Primary auditory measures discussed (see Scheifele et al., 2016 for details)

<table>
<thead>
<tr>
<th>Term</th>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Brainstem Auditory Evoked Response; aka Auditory Brainstem Response</td>
<td>BAER; ABR</td>
<td>Auditory evoked potential generated by the auditory nerve and brainstem in response to acoustic stimuli; commonly used to estimate hearing and auditory acuity and function; waveform peaks within first 10 msec following stimulus onset and are labeled as I, II, III, IV and V; peaks of wave V for the right and left ears = RE-V and LE-V</td>
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<tr>
<td>Auditory Middle Latency Response</td>
<td>AMLR</td>
<td>Event related potential generated by the thalamic, pre-cortical and cortical levels of the frontal and temporal lobes of the brain in response to acoustic stimuli; <em>commonly used to assess higher-order cognitive function</em>; waveform peaks occur within 12-80 msec following stimulus onset = N₀, P₀, Nₐ, Pₐ, Nᵦ, and Pₐ.</td>
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<tr>
<td>Auditory Late Latency Response</td>
<td>ALLR</td>
<td>Event related potential generated by the primary and secondary auditory cortices of the temporal lobe, the mesencephalic reticular activating system and the planum temporale, in response to acoustic stimuli; <em>commonly used to assess higher-order cognitive function</em>; waveform peaks occur within 50-250 msec following stimulus onset and are labeled as N₁, P₁, N₂, P₂, and P₃.</td>
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<tr>
<td>Mismatch Negativity</td>
<td>MMN</td>
<td>An auditory late latency response generated by the primary and secondary cortices of the temporal lobe with contributions from the frontal lobe; <em>commonly used to assess sequential and fundamental brain processes, including pre-attentive analysis of sound features, cognitive processes, sensory memory and the continuous comparison and perception of acoustic stimuli</em>; waveform peaks occur within the latency range of 100-300 msec</td>
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Pete ‘Skip’ Scheifele, MDr, Ph.D., LCDR USN

Kristine E. Sonstrom, Au.D., Ph.D.

Jess Lydon, CVT, with “Chino”
Sample AMLR

14 yo FS Labrador retriever

8 yo MC Australian shepherd

8 month old F German shepherd
Statistically significant ($P < 0.05$) Spearman rank correlations among major auditory variables, noise reactivity status, AIR and SAIR scores.

<table>
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<th>$R_s (P)$</th>
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<tr>
<td>LE-V - RE-V</td>
<td>$r_s = 0.62, (P = 0.001)$</td>
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<tr>
<td><strong>Noise Reactivity - RE-V</strong></td>
<td>$r_s = -0.40, (P = 0.001)$</td>
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<tr>
<td>Noise Reactivity - AIR</td>
<td>$r_s = 0.62, (P = 0.003)$</td>
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<tr>
<td>$N_a - P_a$</td>
<td>$r_s = 0.44, (P = 0.03)$</td>
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<tr>
<td>$N_b - P_b$</td>
<td>$r_s = 0.66, (P = 0.00)$</td>
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<tr>
<td>N1 – P2S</td>
<td>$r_s = 0.46, (P = 0.02)$</td>
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<tr>
<td>N1D – P2D</td>
<td>$r_s = 0.43, (P = 0.02)$</td>
</tr>
<tr>
<td>P2D – P2MM</td>
<td>$r_s = 0.62, (P = 0.000)$</td>
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Findings – AIR scores x auditory assessment

- Affected dogs were relatively *mild*: mean AIR score = 17.65, max = 64 (max possible = 128); SD = 17.82.
- AIR scores for the two groups of dogs were highly significantly different ($t = 4.34$, $df = 19.23$, $P < 0.0004$).
- *There was no statistically significant association for AMLR and AIR score, but there was a highly significant ($P < 0.001$) relationship between RE-V and noise reactivity.*
- But ....the auditory portion of this test should be expanded to a more severely affected population. The domain of generality here is limited.
Findings – global behavior x audiology

• 2 dogs in each group were lost to diseases like otitis media leaving 17 noise reactive and 14 non-reactive dogs.

• 5 of the final 17 noise reactive dogs were too reactive to undergo or complete the test but none of the final 14 non-reactive dogs were unable to undergo and complete testing (G test; P<0.0294).

• The noise reactive dogs different significantly from non-reactive dogs in handling and testing ability.
Conclusions

• Being affected with noise reactivity/phobia – at any level – impairs performance in a problem solving task.

• Being affected with noise reactivity/phobia – at any level – affects how you move when you use environmental and social information.

• Being affected with noise reactivity/phobia – at any level – likely affects many other aspects of your life that are seldom appreciated, but mentally and emotionally painful for the dog.

• Noise reactivity/phobia changes under-appreciated aspects of dogs’ lives.... *it essentially functions to turn off the plastic, problem solving canine brain.*
Acknowledgments

• This research was funded by the US DoD Army Research Office (ARO W911NF-07-1-0074/52731 to KLO) and builds on research originally funded by DARPA (Defense Advanced Research Projects Agency) grants 52731-LS-DRP, and DARPA/UES grant P845, ARO (W911NF-07-1-0074/52731 to KLO).

• Additional support was provided by i4C, the makers of the Voyce band, and Kong.

• Special thanks to: Jess Lydon, CVT, Mark Hines of Kong, Ali Brown and Leslie McDevitt who sent out the original ad, the DTCCC (especially Sabine Platten) who reached out into the training community, and the 186 owners who volunteered > 150 dogs within 48 h, and the >100 incredible owners and >150 dogs who have stayed with us through every single part of this study. You all rock!!!
