Supplementary Materials: Impulsivity as a trait in domestic dogs

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Risk of Bias

To quantify risk of bias for the studies included in our review, we used the Risk of Bias Utilized for Surveys Tool (ROBUST) from Nudelman & Otto (2020). We applied this tool to all 17 analyzed studies (Table 1). Here we describe the eight categories of bias along with justifications for our categorizations, including an overal assessment of risk of bias. We then illustrate the study-level categorizations (Figure S1) and a summary over all studies (Figure S2).

Sampling frame

Sample frame references the correspondence between the theoretical population and the sampled population. It captures the representativeness or generalizability of the sample to the population of interest (in our case all pet dogs). Therefore, we indicate higher bias scores for less representative samples such as only younger dogs (Brady et al., 2018 Study 3), dogs raised in outdoor packs (Marshall-Pescini et al., 2015; Brucks et al., 2019), dogs living in a shelter (Fagnani et al., 2016a Study 2; Fagnani et al., 2016b), restricted numbers of breeds (Müller et al., 2016; Kelly et al., 2019), or combining mixed populations of dogs (Fagnani et al., 2016b; Olsen, 2019 Study 2).

Participant recruitment

Participant recruitment simply refers to whether the authors described how recruitment occurred. Studies without a description received lower scores.

Acceptability of exclusion rate

Exclusions are relatively common in canine behavioral science. However, we scored studies at higher risk of bias if they had large exclusion rates (>33%, Fagnani et al., 2016a Study 1; Müller et al., 2016) or if exclusions were post-hoc with direct impacts on results (Brady et al., 2018 Study 1; see Stevens et al., 2022 for impact).

Sufficiency of sample size

Sample sizes varied from 13-67 subjects across the studies (Table 1). Though admittedly arbitrary, we considered sample sizes less than 25 as high risk, between 25-50 as medium risk, and greater than 50 as low risk. Unfortunately, most studies fall under high risk of bias given their small sample sizes (Figure S3).

Demographic variables

Reporting demographic variables is critical for contextualizing results and comparing across populations. Though all studies reported the sex ratio of their sample, several did not report the neuter status, resulting in less information on subjects and potentially higher risk of bias.

Reliability of measurements

Most studies reported here used existing task designs with reliable measures of impulsivity. However, Mongillo et al. (2019) used a novel design with a more complicated measure than was warranted for studies of spatial impulsivity.

Setting

Experimental setting is critical to animal cognition studies to maintain consistency across subjects. Though most studies tested subjects in the same location, some studies tested subjects at the owner's home (Brady et al., 2018 Study 2; Olsen, 2019), resulting in less consistency in experience and potentially higher risk of bias.

Data management

There were no concerns about how authors addressed missing data, outliers, or invalid responses.

Overall

We weighted sufficiency of sample size, exclusion rate, and setting as the most important criteria for risk of bias. Studies with low bias in sample size or medium bias in sample size and medium bias in up to one other criterion were categorized as low overall risk of bias. Studies with high risk in sample size and medium risk in either exclusion rate or setting were categorized as high overall risk of bias. All other studies were categorized as medium risk.

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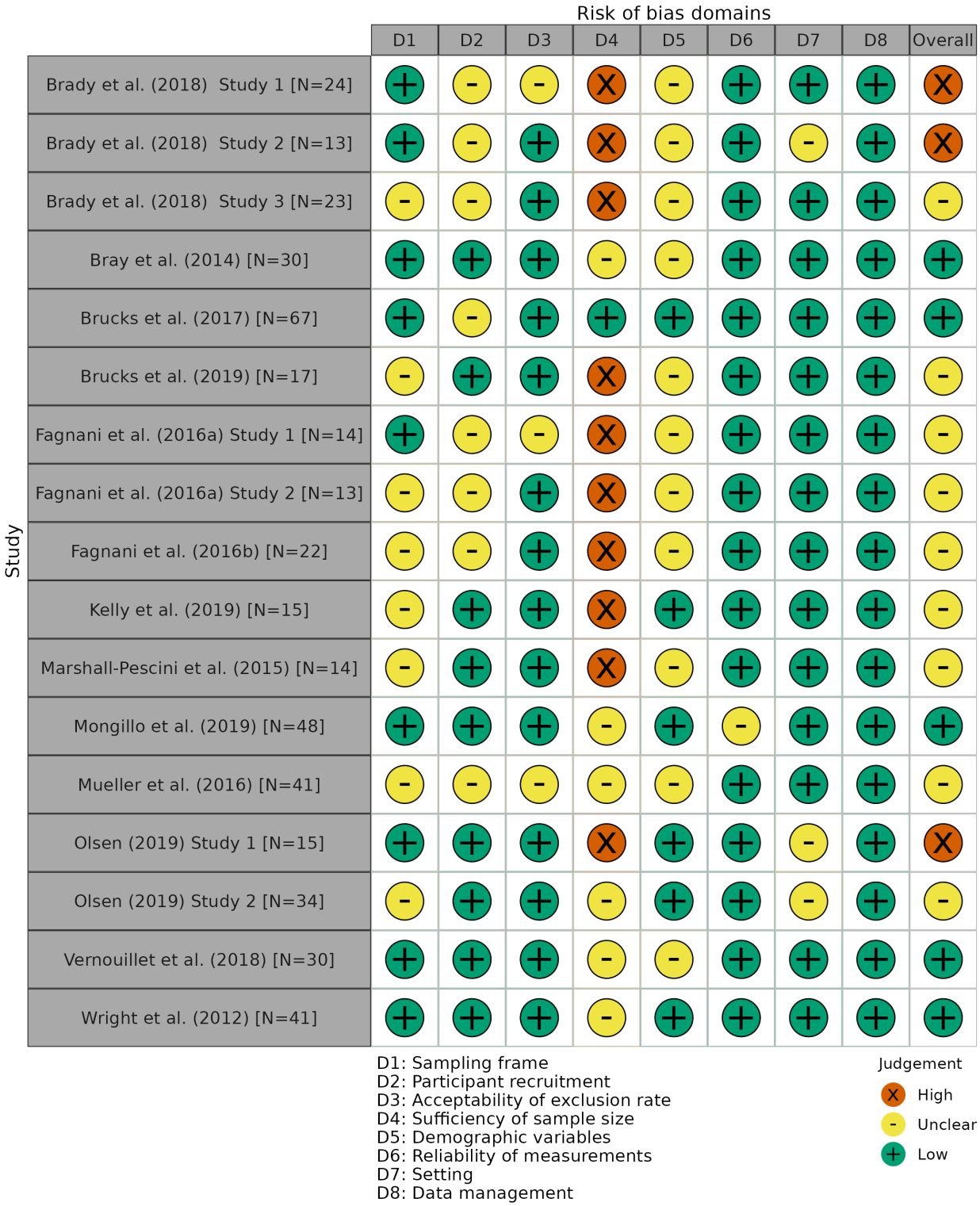

Figure S1: Risk of bias for individual studies.

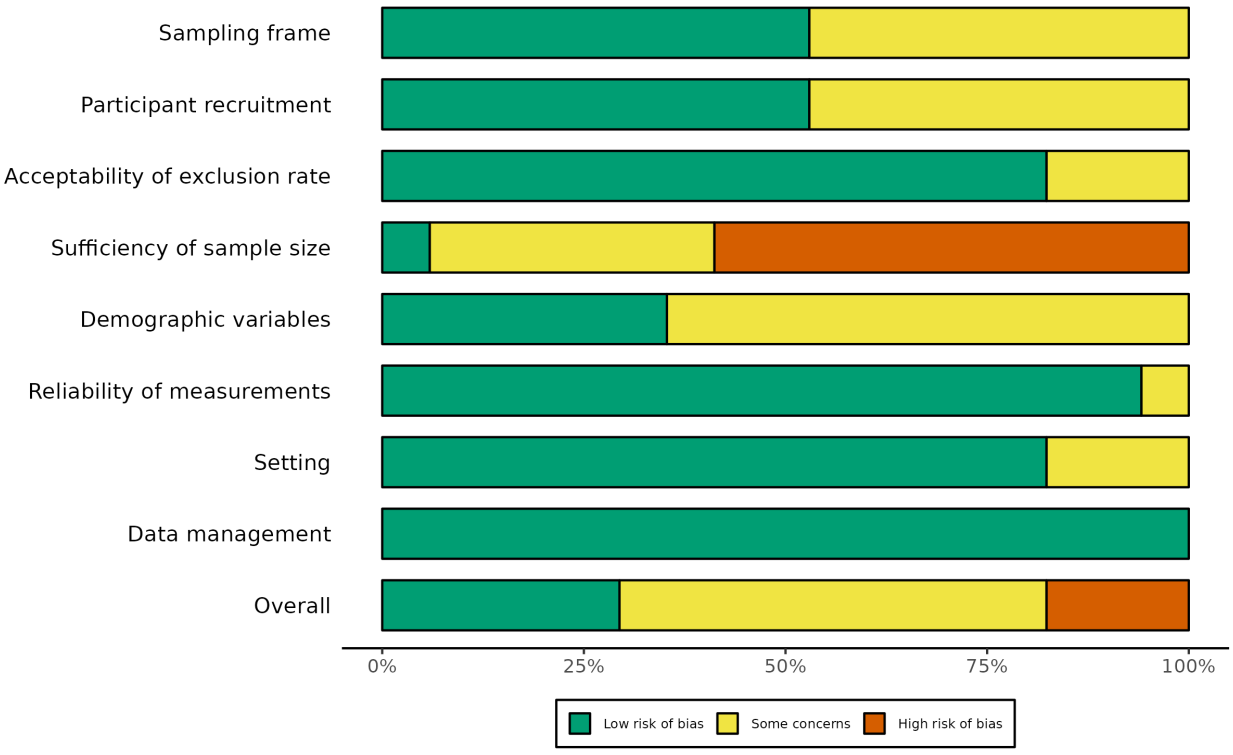

Figure S2: Summary of risk of bias criteria.

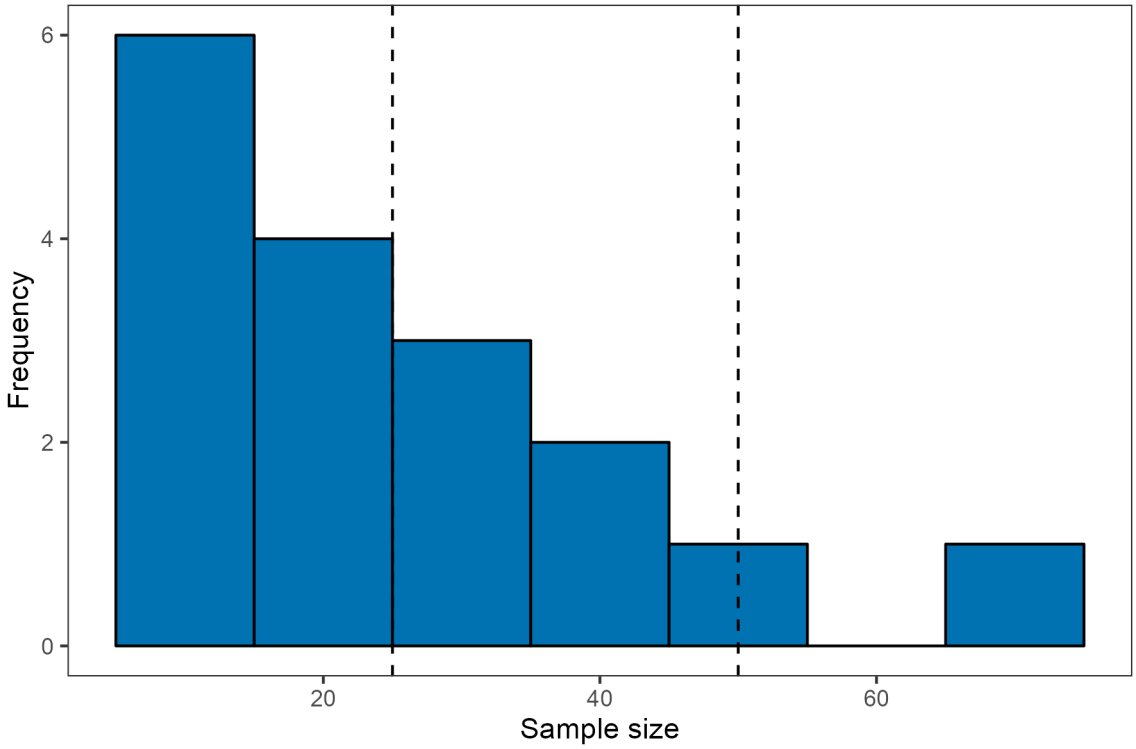

Figure S3: Histogram of sample sizes for individual studies. Dashed lines represent cutoffs for low (N=25) and medium (N=50) sample sizes.