1 Introduction: An Application of Inference with Interference

1.1 What is interference between units?

If treatment effects are defined as comparisons of the two potential responses that an experimental unit would exhibit under treatment or under control (Neyman 1923, Welch 1937, Rubin 1974, Lindquist and Sobel 2011), then an implicit premise of this definition is "no interference between units," as discussed by Cox (1958, p. 19): "There is no 'interference' between different units if the observation on one unit [is] unaffected by the particular assignment of treatments to the other units;" see also Rubin (1986). For instance, widespread use of a vaccine may benefit unvaccinated individuals because they are less likely to encounter an infected individual, a form of interference known as herd immunity; see Hudgens and Halloran (2008). In agriculture, the treatment applied to one plot may also affect adjacent plots; see David and Kempton (1996). In social experiments, people talk, and changing the treatment applied to one person may change what she says to someone else, altering his response to treatment; see Sobel (2006).

In some contexts, interference is of central interest in itself — this can be true of herd immunity or of social interaction, for example — but in many if not most contexts, interference is principally an inconvenience, depriving us of both independent observations and a familiar definition of treatment effects. We apply and extend a recent, general approach to inference with interference (Rosenbaum 2007a) in the context of a cognitive neuroscience experiment in which the brains of a moderate number of subjects are studied using fMRI while faced with a rapid fire sequence of randomized stimuli. In this context, interference is likely to be widespread and difficult to model with precision. The goal is a simple, sturdy, valid method of inference whose conclusions about the magnitude of treatment effects are intelligible when the interference may be complex in form.