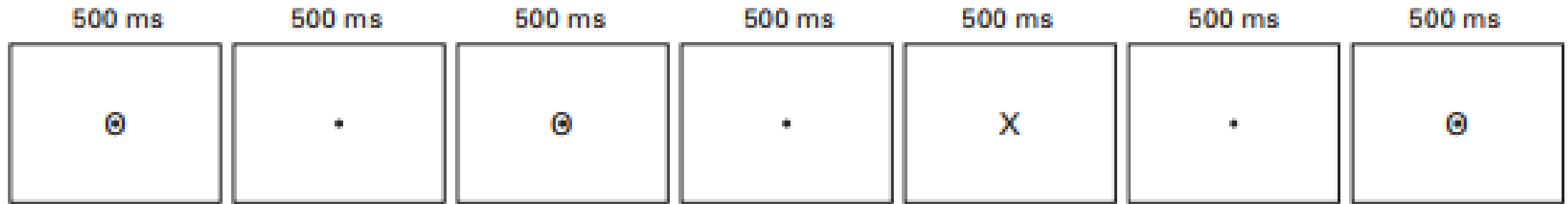


Chapter 4

The Design of ERP experiments



80% O's, 20% X's (no X repetitions), Bright or Dim (in separate blocks), Press button for X's

Common Design Problems and Solutions

- Gedankenexperiment (Thought experiment) will be used throughout this portion
- Designed to examine the effects of task difficulty on P3 amplitude
- Press a button for the target, no response for non-target
- Dim and Bright conditions (different trials)
- Target will not be shown back to back

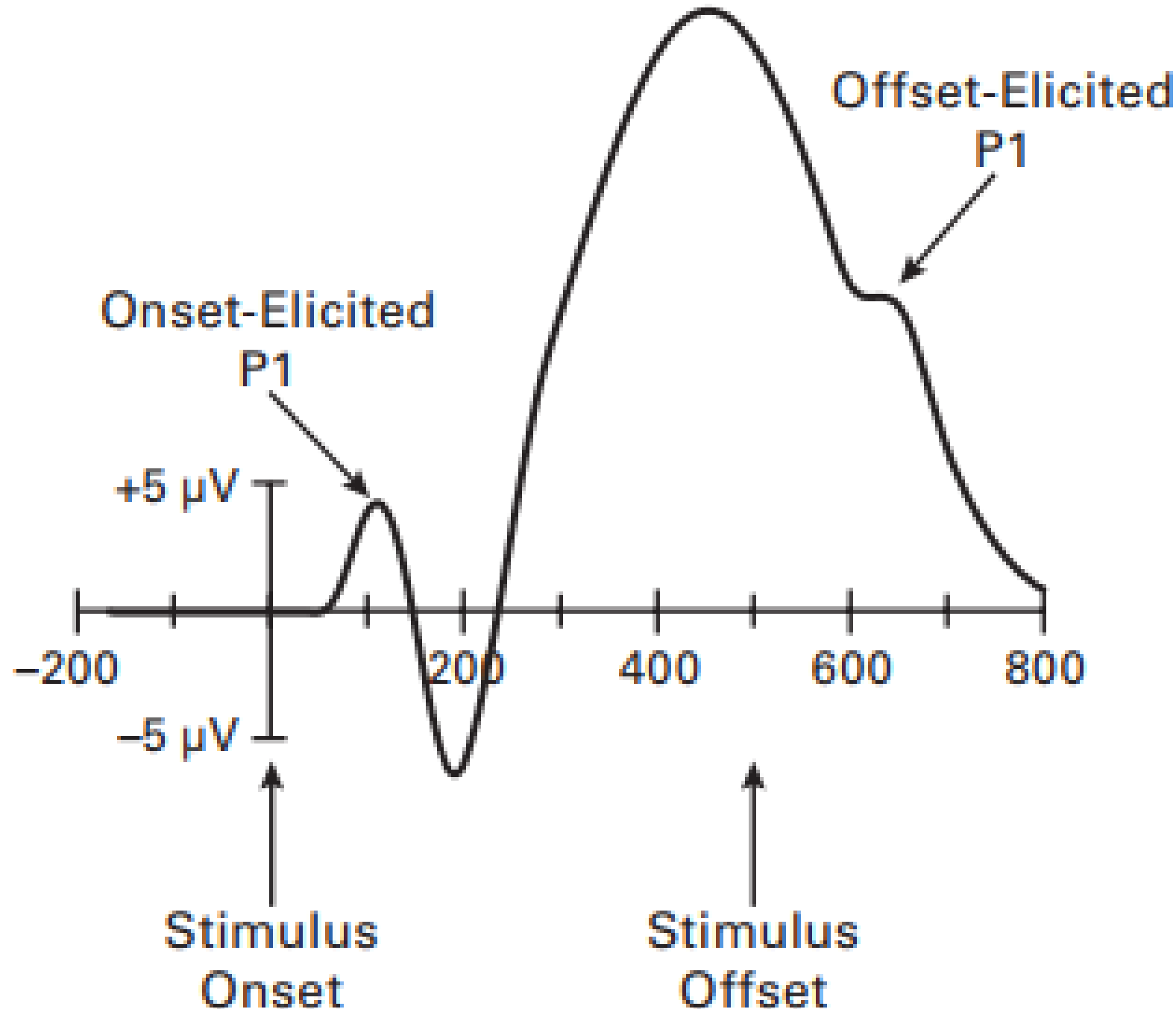
Sensory Confounds

- Target and non-target differ in shape and probability
 - Sensory confounds may produce significant effects as late as 200-300ms
- Solutions:
 - counterbalance the Xs and Os (switch target) or counterbalance across subjects
 - Stimulus-specific adaptation (refractoriness): Use A,B,C,D, and E (same probability of occurrence)
 - Use difference waves
 - Replace of bright/dim task difficulty with size discrimination

The Hillyard principle To avoid sensory confounds, you must compare ERPs elicited by *exactly* the same physical stimuli, varying only the psychological conditions.

Stimulus Duration Problems

- P1 wave's gets larger as stimuli duration increases
- 100 ms does not elicit a distinct onset and offset
 - Perceived as a flash
- What is appropriate?
 - For visual: 100ms
 - For auditory: 50~100ms



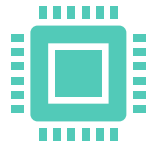
Motor Confounds



The Gedankenexperiment includes a motor confound

Target = press

Nontarget = no press



Could contain motor-related ERP activity



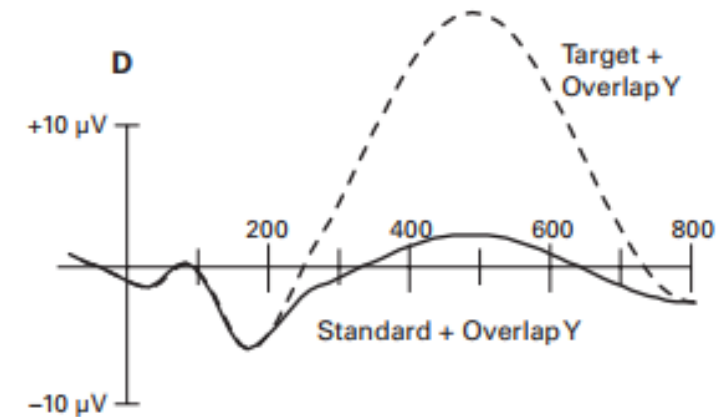
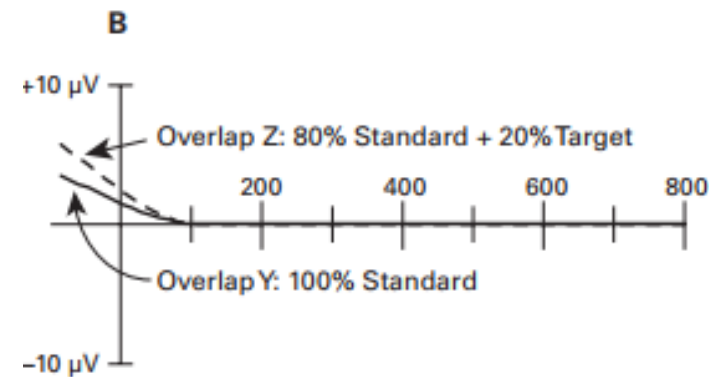
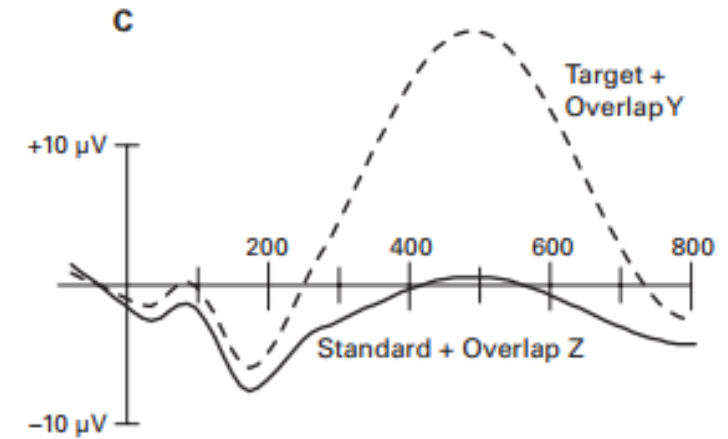
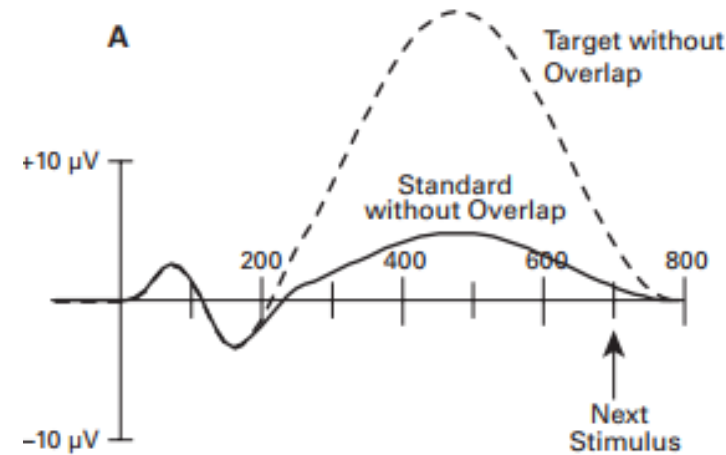
One common solution in oddball experiment is to silently count



Best solution is press one button for A, another button for B.

Overlap Confounds

- Overlap is not usually a problem
- Problem is when overlap differs between conditions
- Exclude trials that were preceded by a target during averaging.
- Make the sequences random so that targets are able to come back to back



Arousal Confounds

- Dim and bright stimuli can affect arousal levels
 - Arousal can increase the amplitude of some ERP components
 - Can also change preparatory activity and produce different baselines
- Best way is to vary the conditions unpredictably within each trial block rather than separating them

Confounds related to Noise and the Number of Trials

- Noise: random variations in the ERP waveform that are unrelated to the brain activity that you are trying to record
 - Adds random variability
 - Reduces probability that real effects in the data will be significant
 - Can bias the data (create a appearance of an effect)
- In the thought experiment
 - Target waveforms = noisier (due to fewer trials)
 - Will bias the peak amplitude
- Two common ways
 - Measure mean amplitude rather than peak amplitude
 - Average the standard trials to equal target trials (same numbers)

Tips for Avoiding Confounds

- Tip 1 : The Hillyard principle
- Tip 2 : conduct control experiments
- Tip 3 : Avoid using peak-based measures, and be careful when comparing ERPs based on different # of trials
- Tip 4 : Avoid comparing conditions with different motor responses
- Tip 5 : Randomize trials.
- Tip 6 : Think about stimulus timing (Offset response & overlap)