Big Data Bowl 2025 Project Summary

Carson Mohler & Grant Starns

Predicting which quarterbacks will succeed in the NFL remains one of the most difficult challenges in sports. Unlike other positions, a QB's performance depends on all 21 other players on the field, coaching schemes, and countless situational factors. But beyond these external variables lies the least understood and arguably most important factor: cognitive ability. The mental demands of reading defenses, working through progressions, and making split-second decisions under pressure represent the most complex cognitive challenge in sports. Traditional measurements like the Wonderlic test failed to capture this in a football-applicable context, and while newer tools like S2 Cognition testing and VR training (Cognilize) have emerged, the development of these skills remains difficult to train outside of live reps.

Time-to-throw (TTT) has long been used as a proxy for QB processing speed, with elite QBs like Brady, Manning, and Mahomes consistently ranking among the fastest. However, TTT in isolation is misleading—play-action heavy offenses, deep-ball schemes, and mobile QBs all inflate TTT without indicating poor performance. There's currently no metric that adjusts for these scheme differences.

My project creates a QB development tool that predicts catch probabilities at scheme-appropriate timing windows. Plays are classified as quick (1.5s), quick play-action (2.0s), deep (2.5s), or deep play-action (3.0s), and the model predicts optimal receiver selection at the moment a QB should have his decision made.

The Big Data Bowl data only provides route labels for targeted receivers, so I built a route classification model (77% accuracy, 12 route types) using ~30 engineered features from tracking data, then applied it to classify all receivers on every play. Play types were assigned using hierarchical rules based on route depth combinations, QB drop-back depth, and play-action flags. For catch probability prediction, I built a CatBoost model achieving 82% accuracy. Features include separation metrics, historical receiver/defender performance, route-specific catch rates, game context, and coverage scheme. Grant tackled the feature engineering for defensive metrics, including tight coverage duration and defender positioning features. After training on targeted receivers, the model assigns catch probabilities to all five receivers per play.

The final product is an interactive Dash application that displays pre-snap formations, routes, and play type classification. Users press play to watch frame-by-frame player movement, and the video pauses at the scheme-appropriate timing window. The user selects a receiver (optionally under a timed constraint to simulate pressure), then receives feedback showing whether they chose optimally and the catch probabilities for all options. They can then watch the actual play outcome. This tool could help develop faster, more accurate decision-making for QBs at any level.