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Relationships Among A Football Specific Test, Wonderlic Test And Decision-Making In NCAA Football Players

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RELATIONSHIPS AMONG A FOOTBALL SPECIFIC TEST, WONDERLIC TEST AND DECISION-MAKING IN NCAA FOOTBALL PLAYERS

By

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This thesis, submitted by William Ratelle in partial fulfillment of the requirements for the Degree of Master of Science from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

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This thesis is being submitted by the appointed advisory committee as having met all of the requirements of the School of Graduate Studies at the University of North Dakota and is hereby approved.

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Table of Contents:

ABSTRACT

Aim. This study compared two different evaluation methods of cognitive ability (Wonderlic and a Football Test) and their relationships to Assign Grade (accuracy of their decision making on the football field). *Methods.* Thirty-seven NCAA football players were given both tests, separated by several weeks. Additionally, the football coaches graded the players' decision making performance with an "Assign Grade," an evaluation of the players' ability to make the correct decisions on the field. *Results.* Spearman *rho* correlation coefficient showed no significant correlations between the Wonderlic Personnel Test and Assign Grade ($r = 0.04$, $p = 0.82$) for any of the groups or player positions. Correlations were higher for the Football Test and Assign Grade ($r = 0.30$, $p = 0.07$), and a positive result was found for the Football Test and Assign Grade ($r = 0.46$, $p = 0.04$), when the specific positions were categorized as "more cognitive demanding." *Conclusion.* There should be more research done to understand the cognitive demands of playing football and type of tests best predict performance.

Introduction

Sport performance requires players to exhibit athletic qualities such as strength, speed, and power, but also include a cognitive ability to recognize, discriminate, and associate correct actions based upon visual cues on the field of play (Garland & Barry, 1990). "Cognitive factors are essential for sport expertise" (Garland & Barry, 1990, p. 1). Football is a team sport that is complex and knowledge-intensive (Stracuzzi et al. 2011) and it is necessary to explore the most effective way to test for its specific cognitive needs.

The NFL uses the Wonderlic (W) (Hatch, 2009) as part of its evaluation of prospective players to examine their cognitive ability. Researchers have shown that there is no relationship between a player's W score and their success on the field (Adams & Kuzmits, 2008). In their study, National Football League (NFL) players were followed over a 6 year period. Success was measured by games played, player salaries, game statistics, and draft order, and none of these had a significant relationship to the players' W score. In another study, football players were given the W and a spatial visualization test (Karthik, 2013). The results showed that the players who performed well on the W also performed well on the spatial visualization test, however, they did not take a measurement of the players' performance on the field (Karthik, 2013). Overall, Lyons (2009) concluded that the Wis not contextual to professional football and has a near-zero relationship with performance.

The W has been moderately linked to general cognitive abilities (IQ) (Matthews & Lassiter, 2007). Researchers using cross-sectional designs have found it to be a strong correlate of intellectual functioning (e.g., Dodril, 1983; Hicks, 2015; Matthews & Lassiter, 2007). However, there is little evidence

that the test includes all domains of cognitive ability (e.g., fluid and crystalized cognitive ability) (Hicks, 2015). Fluid cognitive ability involves solving problems using logical reasoning independent from already acquired knowledge whereas crystalized cognitive ability is more related to general knowledge such as vocabulary words or the of memorizing facts (Matthews & Lassiter, 2007). Both fluid and crystallized abilities are domains of the cognitive ability spectrum, but are understood to be independent. Football requires both of these domains due to players having to know facts about the game and the playbook etc., but also having to possess problem solving skills that come into play when adapting to situational play.

Intelligence is the ability to apply knowledge (Piaget, 1964), and knowledge is context dependent (Allard & Burnett, 1985). For example, football players need to demonstrate their knowledge in football, not through a test of unrelated math and word problems that is the W. Experts in sport, compared to non-experts, are more sensitive to the demands placed upon them by their tasks, are more resourceful organizers, establish fast and precise pattern recognition, and have the ability to categorize at a detailed level (Thomas et al, 1994). Football players being evaluated by the NFL need a sport-specific test to allow them to demonstrate their expertise in football (Hatch, 2009).

This study assessed the strength of the relationship between two different cognitive tests (W and a football test), as well as decision making on the football field (evaluated by the coaches with an Assign Grade). The performance measure was strictly based on the players' decision making on the field, not the execution of their play, because play execution involves other athletic qualities not related to their cognitive ability. It was hypothesized that the more football specific test would better predict the player's performance in decision making on the football field.

Methods

Participants

Thirty-seven football players from the National Collegiate Athletic Association (NCAA) Division 1 University of North Dakota team participated in this study. All positions (offensive line, defensive line, linebackers, defensive backs, and offensive skill positions) were included except for specialists (snappers, kickers, and punters). They were grouped according to offense (*n* = 17; 45.9%) and defense (*n* = 20; 54.0%) and also according to the cognitive demands of the position (more demanding: *n* = 20; 54.0%; less demanding*: n* = 17; 45.9%). The grouping of more or less cognitive demanding positions is explained later. All of the participants were males with an average age of 20.43 years (*SD* = 1.21) and 2.48 years of NCAA playing experience (*SD* = 1.04).

Measures

Football Test (FT)

This test was designed by the primary author of the study. The participants were shown a total of 15 clips of film of various football plays. The camera view was from the sideline which is the only angle that can show the entire field. Their task was to verbally identify everything that they saw that they determined to be relevant information to the play and its outcome, in real time. They were given the duration of the play to state all of their answers. They were seated 9 feet away from the projector screen(3 meter diagonal display). Before each clip, the projector screen displayed a black screen for 3 seconds to standardize the time in which the participants saw the film before the play started. According to expert opinion (NCAA football coaches), three seconds is the amount of time players should be able

to interpret all of their initial visual cues. The participants looked at a black screen for 3 seconds, then the film would appear with the snap being 3 seconds after that. The participants had until the ball carrier was declared down to visually recognize and verbally respond to the play. For example, in one clip, an answer by the participant should be as follows, "Hog, Gun Strong, Orbit, Drop Back Pass, Slip Screen Right." Different clips of film were shown to the offensive players (includes positions offensive line and offensive skill) than the defensive players (defensive line, linebackers, and defensive backs), but the same clips were shown in the same order to the participants of the same position. The participants were not given feedback because the author did not want to influence the performance of the participants. Indirect methods were used, such as allowing the athletes to verbally respond to what they see, as opposed to direct methods such as recording the eye fixations of the athlete. This method was the same as used in a recognition accuracy study with basketball athletes (Allard, Graham & Paarsalu, 1980; Millslagle, 2002).

All 15 clips were shown in one session. The participants' responses were scored according to an answer key provided by the coaches (they reviewed all of the film that was shown to the participants and produced an answer key that outlined what the relevant information was). For each clip, there were a range of 3-7 correct responses. Not every clip was worth the same amount of points. The total score for correct responses for the defensive film was 57 and for the offensive film was 40. The author added up the total amount of points scored by each participant, and divided that number by the total number of points possible to give the participants a standardized percentage score.

Wonderlic

The Wonderlic Test *(W)* is a 12 minute, 50 question standardized test that is compiled of basic math and word problems (McKelvie, 1989). The NFL uses it as part of its evaluation process to assess standard cognitive ability for prospective players. The prospective players take the test when scouts visit them on campus, at the NFL combine, and at their pro days. The W contains questions that are unrelated to the content of football. To complete the W, participants sit at a desk where the test is face down and when the proctor says "begin" the test is flipped over and participants to have 12 minutes to work on it. After 12 minutes is complete, the participants put their pencils down, leave the test on their desk, and are dismissed. Scores can range from 0-50 possible points on the W.

Assign Grade

As part of spring football practice assessment by the coaching staff, the players were graded every snap that they were on the field. They were given a plus or a minus for their assign grade on each play. The assignment grade is an evaluation of the players' decision making on the field; it evaluates whether or not the player attempted to take the correct action. It is not an evaluation of the player's execution. A plus means they made the correct decision on the field and a minus means that they did not make the correct decision on the field. The coaches tracked all of the plays during 15 practices for each player. The number of snaps played by each participant varied by individual with an average of 116.97 (65.60). Each participant was given an overall percentage score at the end of spring practice which was used as the Assign Grade measure.

Procedure

Approval to conduct this study was granted by the Institutional Review Board. Participants were recruited by the primary investigator. At a team meeting, football players were asked to participate in a study about how their cognitive ability relates to their football performance. Written consent was obtained from all athletes prior to scheduling testing sessions. After arriving to the room at their designated time, they were shown an example of the FT to ensure that they understood the expectations of the test. As the participants were being tested, the researcher was in the room grading their answers for every clip (they were not told what their scores were). A few weeks later, they came to the room in a group arrangement to take the W. Assign Grade scores were obtained by the coaches at the end of the spring practice season.

Data Analysis

Descriptive statistics for all tests were presented as means and SD. Data were evaluated for normality using histograms. Spearman *rho* correlations were computed among the primary measures (FT, W, and Assign Grade).

Results

Descriptive information for all variables can be found in Table 1.

Sample	**(FT)**			**(W)**			**Assign Grade (AG)**			r (FT, W)	r (W, AG)	r (FT, AG)
	Mean	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*			
Total (*n* = 37)	35.89	16.19	11.00-75.00	22.35	6.75	5.00-42.00	84.81	18.19	60-100	.17 (*p* = .31)	.04 (*p* = .82)	.30 (*p* = .07)
Offensive (*n* = 17)	32.53	14.16	13.00-73.00	21.53	6.53	5.00-28.00	78.82	13.77	60.-100	.24 (*p* = .36)	.04 (*p* = .89)	.31 (*p* = ..23)
Defensive (*n* = 20)	38.75	17.58	11.00-75.00	23.05	7.02	14.00-42.00	89.90	7.93	62.-98.	.17 (*p* = .47)	-.09 (*p* = .71)	.08 (*p* = .75)
More cognitive demanding (*n* = 20)	42.20	17.54	13.00-75.00	23.90	6.03	14.00-42.00	86.40	10.37	62-100	.16 (*p* = .49)	-.15 (*p* = ..53)	.46 (*p* = .04)
Less cognitive demanding (*n* =17)	28.47	10.79	11.00-47.00	20.53	7.27	5.00-32.00	82.94	14.14	60.-100	.08 (*p* = .77)	.27 (*p* = .30)	.13 (*p* = .61)

Table 1. Correlations across the three computed variables

FT was moderately, albeit nonsignificantly, correlated with Assign Grade (*rho* = 0.30, *p* = 0.07). Participants who scored high grades on the FT tended to grade out higher by their coaches for their assignment grade. W was a negligible correlate of Assign Grade (*rho = 0.04).* Scatterplots of these relationships are shown below. The correlation between the FT and W scores was .17, (*p* = .30). Scatterplots for these variables are shown in Figures 1 and 2.

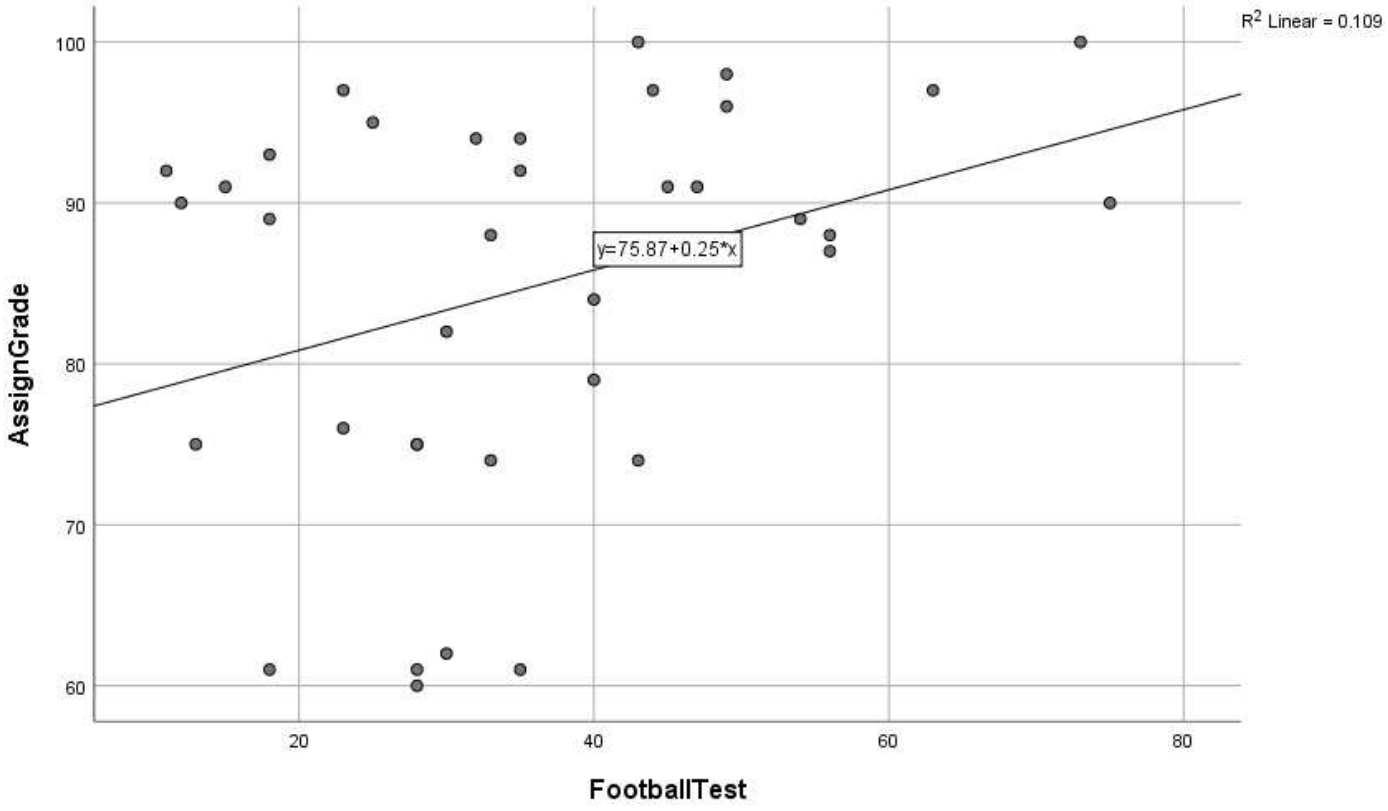

Figure 1. Scatter plot representing the correlation between the Football Test and the participants' Assign Grade score.

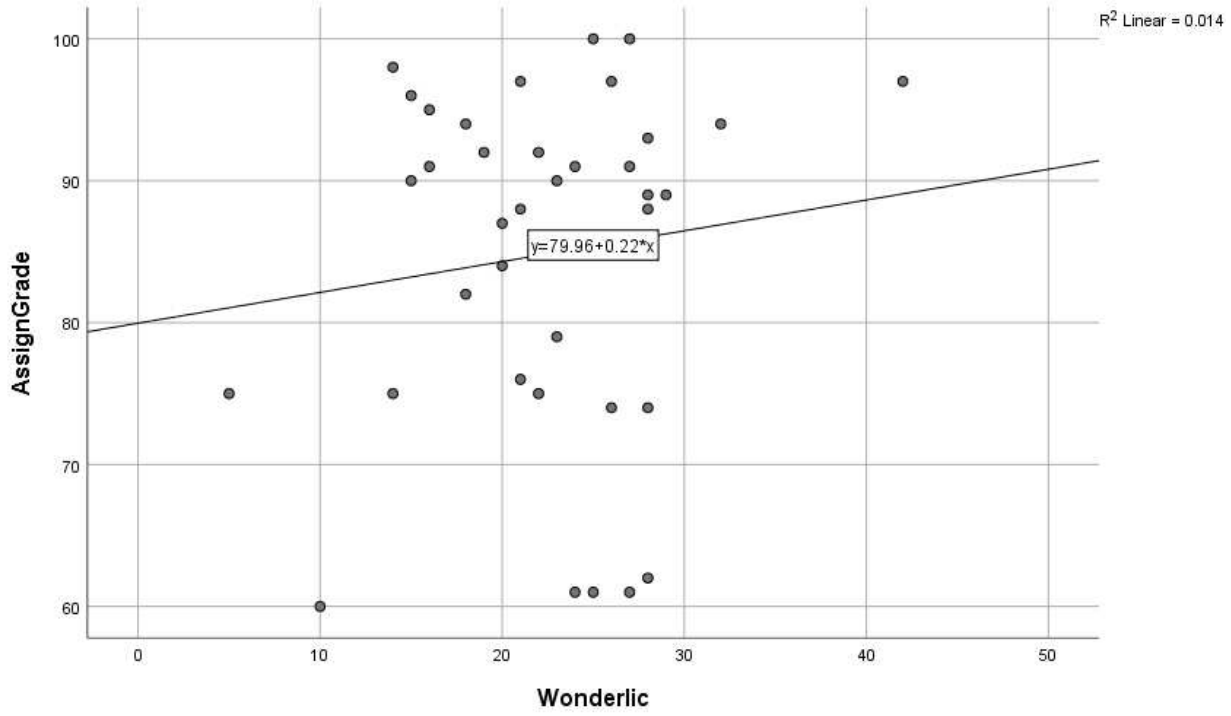

Figure 2. Scatter plot representing the correlation between the Wonderlic and the participants' Assign Grade score.

A trend in the data led to an analysis based on the cognitive demands of the participants' positions. According to Packman (2008), positions closest to the ball placement on snaps are considered more cognitively demanding (e.g., quarterbacks, offensive linemen) than other positions which line up further away (e.g., wide receivers). Using this information, the participants were split into two categories. The two categories were positions that seemed to have a greater cognitive load on their performance (linebackers, safeties and offensive linemen), and positions that seem to have a lesser cognitive load on their performance (defensive linemen, cornerbacks, and offensive skill). The data for these two categories being split can be found in Table 1. There was a moderate, positive correlation between FT and Assign Grade (rho = 0.46, p = 0.04). The correlation for the less demanding positions was not statistically significant. Scatterplots are shown in Figures 3 and 4.

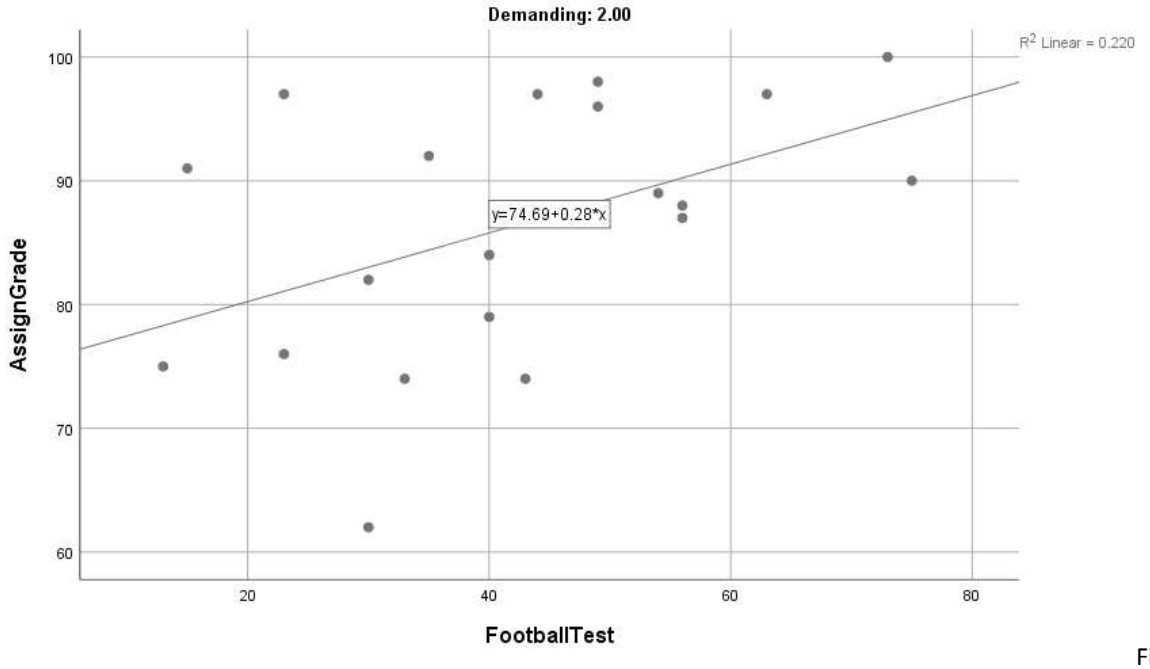

Figure 3.

Figure 3. Scatter plot representing the correlation between the Football test and the participants' Assign Grade score.

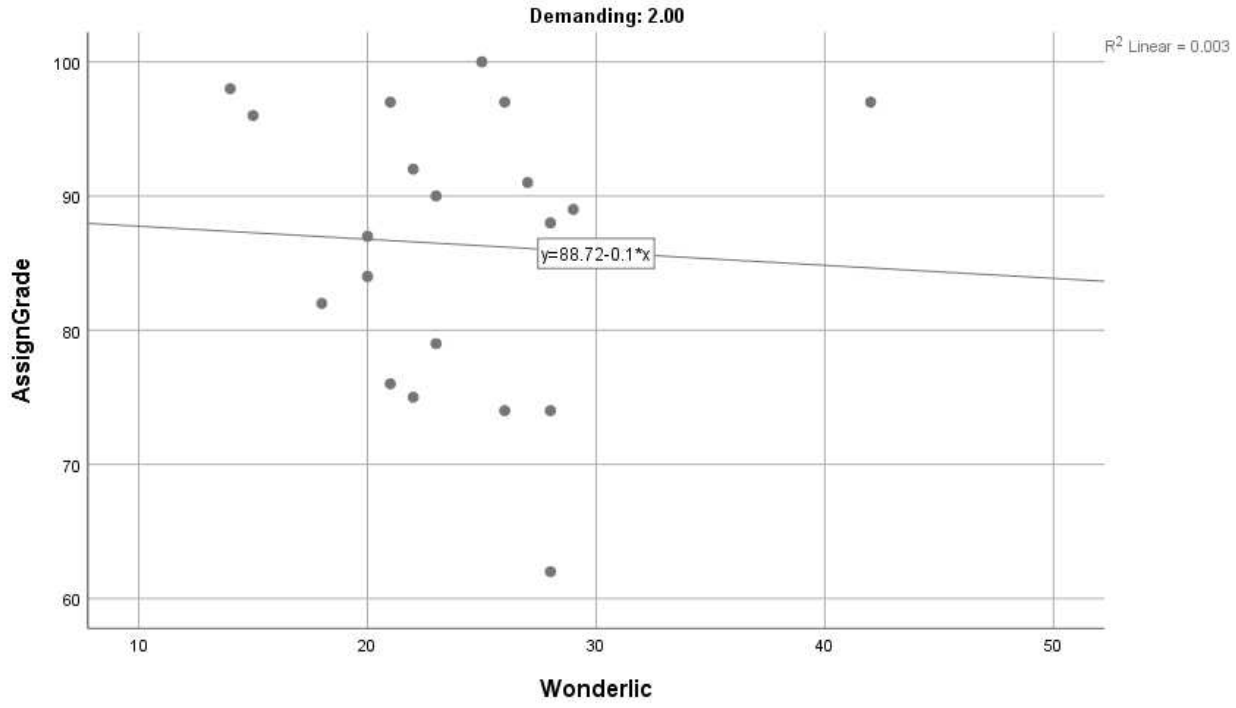

Figure 4. Scatter Plot representing the correlation between the Wonderlic and the participants' Assign Grade score.

Eight of the participants did take the FT for a second time to measure the consistency of the test. The results are below in figure 5.

	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.990[a]	.952	.998	202.786	7	7	.000
Average Measures	.995[c]	.975	.999	202.786	7	7	.000

Figure 5. Intraclass Correlation Coefficient for the FT.

Discussion:

The results of this study showed that the Football Test had a stronger relationship to Assign Grade compared to the W but there was only a significant relationship when we stratitied the analysis by the cognitive demands of position played. The expectation was that there was going to be a stronger correlation between the FT and Assign Grade. The results indicate the though the FT was not was an effective measure to use for most football positions, though it was better than the W. Other researchers who have researched cognitive ability in the sport of football have reported similar findings when it comes to the validity of the W in its relationship to intelligence, and specifically how it relates to football performance (Hicks et al., 2015). "A football specific test would provide more useful information for teams in assessing players." (Hatch, 2009).

That the correlations between the W and the FT were all very low (ranging from .08 to .24) shows that these two measures were assessing very different constructs. When the participants were stratified by offensive and defensive playing position, the FT scores were higher on average for the defensive group. The W scores were also higher for the defensive group. This finding was not the norm when compared to other research studies comparing offensive and defensive position players and their W scores (Adams & Kuzmits, 2008; Packman, 2008; Lyons et al., 2009). Defensive participants also scored higher on their Assign Grade than the offensive players on average.

The correlations among all tests were lower for defensive positions than for offensive positions, though none of the values were significant. This result is novel when comparing it to previous research that has shown positions that line up closer to the ball may have a greater cognitive demand placed on them (Packman, 2008). These positions would include both offensive and defensive players. These results could explain that there needs to be an even more specific football test to evaluate and measure

the cognitive demands of each position. Not every position is required to read the same things each play, so showing the same film to different defensive players may not be an effective strategy of evaluation (Packman, 2008).

When the data set was split into a more cognitive demanding group and a less cognitive demanding group, the more cognitive demanding group performed better on all three of the assessments (FT, W, and AG). There was little relationship between the FT and the W. The highest correlation was again between the FT and the AG. The W scores even had a negative correlation. The FT had the highest correlations with Assign Grade for the offensive group, defensive group, more demanding group, but not for the less demanding group in which case the Wonderlic Test was higher (but not by much). It could be suggested that a more position specific test should be tried, instead of a general offensive and defensive test. It is unclear as to why certain positions, such as defensive backs, perform better on the field but when given the same sport specific cognitive test, they perform worse compared to other positions. A hypothesis that different positions focus on different visual cues on the field and some positions may have a larger scope to see on the field while other position have a more narrow scope. For example, a defensive back may only have to see half of the field and only read 1 or 2 opponents while a linebacker may have to see the entire field/formation/back field sets etc. therefore having more opportunities to make incorrect reads compared to a defensive back. Having these responsibilities on the field may be an advantage to the linebackers when it comes to the FT that was given because they can demonstrate all of the things that they see and recognize compared to the defensive backs who may be more comfortable just concentrating on a smaller number of things on the field. But on the field the two positions have vastly different responsibilities, linebackers may have more

to see and recognize than defensive backs. So if a linebacker goes 5 for 6 on those visual cues that must be recognized on the field, the one miss gives them a negative on the assignment grade by their coaches. But if a linebacker goes the same 5 for 6 on the FT, he will be given an 83% for that play on the FT. If the defensive back is shown the same clip of film but only recognizes 2 of the 6 keys, he is given a 33% for the play on the FT, but in actuality, maybe that is all he needs to see to perform well during a game or practice.

Another possible explanation may be that certain positions require higher cognitive demand to play. Defensive linemen do not have to understand pass coverages nor make as many reads as other defensive positions. They are given their assignment prior to the snap and they try to execute it without much deviation. A limitation that may or may not have impacted the results is that the football specific test was too generalized. There were only two different tests. One for the offensive players and one for the defensive players. And the correct answers that the players were supposed to have given, were the same, regardless of their position on the field. Defensive backs, linebackers, and defensive linemen all saw the exact same plays on film and were expected to give the same answers of what they recognized. The same goes for the players of different positions on offense. It would make sense that if there was a more specific test, showing clips with more sophisticated situations relating to each players' position, that results might have shown a stronger correlation to their assignment grade. Maybe wide receivers should have a test that only focuses on specific alignments of defensive backs and coverages, eliminating fronts and pressures by the defensive line and linebackers. Maybe defensive linemen should be given film that only focuses on backfield sets and what the movement of the offensive line looks like. This should eliminate the outside context that really doesn't matter to certain positions.

Research done by Hepler and Feltz (2012) concluded that when there is a time constraint on decision making in sports that the lack of time may actually aid in performance, in this study the participants were under a time constraint with no more than 3 seconds to see the screen before the play began and were expected to state all of their answers before the ball carrier was declared "down." "Chunking" has been characterized and popularized by Chase and Simon (1973) as a strategy for processing information visually, it is possible that the positions in the more cognitive demanding group are more competent in using this strategy than the positions in the less cognitive demanding group because they are required to see more on the field and therefor can demonstrate it better when given a test containing football specific content, such as the one in this study.

The results of this study may imply that different positions have different needs of assessments. This study provides some insight to the different cognitive demands for different football positions, though it doesn't provide enough for us to conclude that we know exactly what those demands are. Maybe certain positions require more or less cognitive ability than other positions.

Limitations of this study include the angle of the camera for the film that the subjects were viewing on film. The angle was from the side line and high up top. A more realistic angle would be that of on one side of the line of scrimmage and down on the field. A second limitation of the study is that we discovered that the football test may have been too generalized. Some positions may have not been given opportunity to demonstrate their knowledge of the game that may contribute to their performance on the field. We were able to recruit 37 participants which is a little under half of a typical college football team. Finally, the participants' Assign Grades may have been influenced do to the number of plays that they participated in on the field during practice.

The next steps should be to form a more specific football test with different content for each position. This could be done by thoroughly understanding the demands of each position. Consulting experts in football such as coaches, scouts etc. would most likely need to be done. And to make a football test that is practical for more people involved in football would be to have the answers of each clip to be universal terms. Using universal terms would allow for more teams and players to partake in the evaluation without having to formulate their own answer keys. If this study were to be done again, these are the primary changes that should be made. Future research should consist of more tests that contain more content specific to the sport of football, and the tests should contain content that is specific to each position. It might require football experts, such as coaches, to develop these tests. Maybe different positions will need to be shown clips from different camera angles, wider or narrow lenses, or more specific reads down to the level of player splits, player body language ect. Ecological validity will be an important factor in future research as well, being able to put the suggestions in practice is what drives time, energy and resources to make changes happen.

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