

**High Versus Low
Fidelity Simulations:
Does the Type of Format
Affect Candidates'
Performance or Perceptions?**

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INTRODUCTION

Simulations have become a popular and effective way to select employees for a job. There are several different types of simulations, including assessment centers (Thornton & Byham, 1982), work samples (Asher & Sciarrino, 1974), situational interviews (Latham, Saari, Purseli, & Campion, 1980), and paper-pencil management simulations (Motowidlo, Dunnette, & Carter, 1990). Simulations are different from other tests such as multiple-choice exams because they require the candidate to physically and verbally respond to situations that are typical for the job for which the candidate is applying. Candidates are assessed based on the quality of the actions they take. Therefore, these tests are designed to sample job behaviors rather than provide signs of underlying temperament or other traits that are assumed to be necessary for job performance (Motowidlo et al., 1990). The simulations that were listed earlier are all very different in the way they are administered but they all have one characteristic in common. They represent samples of likely performance rather than signs of possible performance (Wernimont & Campbell, 1968). Simulations are based on the idea that “behavior predicts behavior.” They also allow the candidates to be measured on specific knowledge, skills, and abilities. The way a candidate behaves during a simulated exercise will provide a good indication of the way he/she will behave on the actual job. Based on that idea, simulations should be a valid method to identify how an individual will perform on the job.

Simulations can be broken down into two different groups: high fidelity and low fidelity. High fidelity simulations utilize very realistic materials and equipment to represent the task(s) that the candidate must perform. Assessment centers and work sample tests are examples of high fidelity simulations. Several meta-analytic reviews have shown impressive support for the validity of these tests (Hunter & Hunter, 1984; Schmitt, Gooding, Noe, & Kirsch, 1984). Low fidelity simulations use materials and equipment that are less similar to what is used on the job. An example of a low fidelity simulation would be one in which the candidate is presented with a verbal description of a hypothetical work situation and then asked to describe how he/she would deal with the situation rather than having the candidate perform the actions he/she would take (Motowidlo et. al., 1990). Situational interviews and paper-and-pencil management situations are both examples of low fidelity simulations.

Since high fidelity simulations better resemble the job for which the candidate is applying than low fidelity simulations, it would make sense that high fidelity simulations would be better predictors of future job performance. The problem is, it is not clear the extent to which fidelity must be increased in order to ensure the simulation will be a good predictor. High fidelity simulations may be better predictors but they also have several disadvantages that may make them less useful. This paper examines the advantages and disadvantages of both high and low fidelity simulations. Next, we

examine specific types of high and low fidelity simulations that are currently being utilized in several fire departments in the Northern Virginia area. Finally, we review the results from the analysis of several tests that were administered to these fire departments. These results provide useful information regarding the use of high and low fidelity simulations. Candidate perceptions of both types of simulations are also discussed.

Advantages and Disadvantages of Both Types of Simulations

As mentioned previously, it would seem that high fidelity simulations should provide a better indication of how a candidate will perform on the job. Based on that assumption, one would think that every company and government agency would want to use high fidelity simulations.

High fidelity simulations have high face validity due to their similarity to the target job (Chan & Schmitt, 1996). Candidates will be less likely to object to a test which places them in a realistic situation. On the other hand, when candidates feel they are being asked questions that are irrelevant to the job for which they are applying, they are more likely to challenge the test. Several studies have shown that tests involving simulations produce more favorable candidate reactions than paper-and-pencil tests (Macon, Avedon, Paese, & Smith, 1994; Smither, Reilly, Millsap, Pearlman, & Stoffey, 1993). Candidate perceptions of the testing process are important because they can affect the likelihood of litigation and the utility of the test (Smither et al., 1993).

Another advantage of high fidelity simulations is they serve as a realistic job preview (RJP) (Weekley & Jones, 1997). This means the simulation provides the candidate with an idea of what the job will truly be like. Providing the candidate with a realistic preview of the job for which he/she is applying may strengthen the candidate's desire to stay on the job, once he/she is hired. It is beneficial for the company or government agency to utilize RJP's during the selection process for a position because candidates will only remain in the selection process if they are still interested in the job. This may help to reduce the time and money spent during the selection process.

High fidelity simulations have several disadvantages, which is why they are not used as often as one would expect. First, they require more departmental resources including personnel and equipment. This means that equipment must be set aside for the test and cannot be used by current employees on the job. Secondly, these tests are usually more time intensive and more expensive to administer.

There are several advantages of low fidelity simulations. Many companies and government agencies prefer to use them because they are less expensive than high fidelity simulations. If there are a lot of candidates, many small companies and government agencies do not have the funds to pay for high fidelity tests. Also, low fidelity tests do not require many departmental resources. The tests do not utilize the equipment used on the job which means this equipment can be used by current employees to perform their work.

The main disadvantage of low fidelity simulations is they are less realistic. Therefore, it is not necessarily as clear to the candidate what the simulation is assessing. This tends to lead to more complaints about the simulation exercise. This also means low fidelity simulations do not provide a RJP.

Fire and Rescue Emergency Incident Tests

Assessment centers developed for many fire and rescue departments include either low fidelity or high fidelity emergency incident simulations. In general, these simulations place the candidate at some type of emergency scene (e.g., house fire, car accident) and the candidate is assessed on how well they handle the emergency. These type of exercises allow the department to assess many important knowledge, skills and abilities, including knowledge of department operations, ability to manage an emergency scene, and ability to manage stress.

A low fidelity emergency incident simulation is conducted inside a room. They are usually either written or presented orally using equipment that is not used in the field, such as a fire simulator. Some low fidelity simulations do not utilize any equipment at all. One type of low fidelity simulation involves a fire simulator computer program that allows for the projection of a picture of a structure fire. The candidate will see a building with fire coming from some part of the structure. The candidate may be given a radio and he/she will be able to communicate with and give orders to personnel on other engines, trucks and medic units. The candidate will never actually see these individuals but the units will be able to communicate with the candidate during the entire incident.

High fidelity emergency incident simulations involve actual fire resources and extinguishing products that are used in the field, and they are created to be as close to real life as possible. They are usually conducted at a burn building that is used by the department to conduct training. The candidate will ride to the fire in a real engine or truck and they will use real equipment and resources to put out the fire (i.e., hoses and water). There are other firefighters and medic personnel at the building to help the candidate deal with the situation. The high fidelity test may involve a real fire or there may be just smoke showing without a fire. Dummies and/or role players can be used to simulate victims.

Due to the method in which high fidelity emergency incident simulations are conducted, there are additional disadvantages to this type of test. It is very important to ensure that every candidate takes the test under the same or very similar conditions. Unfortunately, high fidelity tests are conducted outside, which is an environment that cannot be controlled. Therefore, it is more difficult to ensure that every candidate will have the same conditions. For example, it is not always easy to make sure the fire is at the same intensity level for every candidate. High fidelity tests are also affected by the weather. One candidate may have to take the test in the rain while another candidate might have a sunny day. Another disadvantage is there are more safety issues involved with high fidelity simulations. If a fire is being used in the test, a safety Officer from the department must be present to ensure everything is done in a safe manner. Also, not all departments have the facilities to conduct high fidelity simulations. Therefore, they must coordinate with other departments who are willing to share their facilities.

Since low fidelity simulations are conducted inside, the testing environment is consistent. Weather is never a factor. The fire is a computer image so it is very easy to ensure that it will be at the same intensity level for every candidate. Also, safety is never an issue since the candidate will be in a testing room for the entire exercise.

Hypotheses

Fields Consulting Group, Inc. (*FCG*) reviewed test data from three fire and rescue departments in order to examine the differences between low and high fidelity emergency incident simulations. Based on the advantages and disadvantages of these simulations and from our experience developing tests, we formulated two hypotheses. The first hypothesis is that candidates' scores on high fidelity simulations are higher than scores on low fidelity simulations. Since high fidelity simulations are more realistic and more similar to the way the candidates are trained, candidates should perform better on these simulations. The second hypothesis is that candidates have more positive perceptions of high fidelity simulations due to their high level of realism.

Methods and Results

The data were collected from three fire departments for candidates ($N = 159$) who participated in promotional processes for ranks including first line supervisors and middle management fire positions. Table 1 identifies the number of candidates who took each test, the rank that was tested for and the type of simulation that was used in the test (e.g., low or high fidelity). Seven of the tests involved high fidelity simulations and there was a total of 81 candidates. Five of the tests involved low fidelity simulations and there was a total of 78 candidates.

Hypothesis 1

An independent t-test was run to identify if there were any significant differences between the candidates' scores on the high and low fidelity simulations. The findings suggest there were no significant differences in candidates' scores on low ($\bar{x} = 77.34$) and high ($\bar{x} = 78.91$) fidelity tests ($t = 1.10$, n.s.).

Next, the overall scores on all of the emergency incident simulations were broken down by competencies in order to see if any significant differences could be found between the candidates' scores on the high and low fidelity simulations. Candidates were assessed on their performance on four to six competencies in each of the emergency incident simulations. The individual competency data was available for all of the simulations except for the high fidelity simulation that was used to test 14 Captain candidates. Some of the competencies were similar such as reasoning and judgement and analytical ability, so these competencies were combined. After combining some of the competencies, a total of seven competencies remained. Three of the competencies were only assessed in the high fidelity simulations. Therefore, the data for these competencies could not be used for this analysis. Independent t-tests were run on the other four competencies. Reasoning and judgement/ analytical ability was the only competency which produced significant t-test results ($t = 3.17$, $p > .05$). Refer to Table 2 for all of the independent t-test results. These results indicate that candidates who took the high fidelity simulations received higher scores on reasoning and judgement/analytical ability than those who took the low fidelity simulations.

Table 1: Information on Tests Used in Data Sample

N	Rank	Type of Simulation
8	Technician II	High fidelity
8	Technician II	High fidelity
27	Lieutenant	Low fidelity
10	Lieutenant	High fidelity
7	Lieutenant	High fidelity
29	Lieutenant	High fidelity
10	Captain	Low fidelity
15	Captain	Low fidelity
16	Captain	Low fidelity
5	Captain	High fidelity
14	Captain	High fidelity
10	Battalion Chief	Low fidelity

Table 2: Analysis of Competencies

Competency	N	Mean	Standard Deviation	t-Test Results
Reasoning and Judgement/Analytical Ability	H = 67 L = 78	H = 4.39 L = 3.73	H = 1.0 L = 1.42	t = 3.17, p > .05
Knowledge of Department Operations/Knowledge of Incident Command System	H = 67 L = 78	H = 4.86 L = 5.13	H = 1.14 L = 1.14	t = -1.38, n. s.
Ability to Coordinate Activities/Manage Emergency Scenes	H = 60 L = 78	H = 4.65 L = 4.33	H = 1.19 L = 1.15	t = 1.58, n. s.
Oral Communication Ability	H = 67 L = 78	H = 5.45 L = 5.69	H = .97 L = .92	t = -1.56, n. s.

H= High fidelity; L= Low fidelity

Hypothesis 2

We interviewed four fire personnel who participated in these simulations. Our hypothesis is that candidates have more positive perceptions of high fidelity simulations due to their high level of realism. Most of the feedback we received supported this hypothesis. A Lieutenant who was interviewed stated that the fire simulator should be used for training, but not for testing. According to him, the tests using the computer simulator are not close enough to reality. He believes the high fidelity simulations are a better test to see how candidates will react during a real emergency incident.

A Captain that was interviewed expressed similar feelings to those of the Lieutenant. He said that the low fidelity simulations are made to be as “perfect as possible but there are no real life cues to trigger a candidate’s thoughts.” He stated that when a candidate is taking a high fidelity simulation, he/she can use all or most of their senses. The candidate can smell the smoke, touch the equipment and the building, hear the fire, and see the fire and every side of the building. Firefighters are able to use their senses to manage a real emergency scene. The Captain also stated that he believed new firefighters would do better on the high fidelity simulation because that is the way they have been trained in recruit school. Fire personnel who have taken several tests might be able to do as well on a test using the simulator as they would on a high fidelity simulation because they have become more test-experienced. Finally, he admitted that high fidelity simulations are very resource intensive but he believes the expenses are justified because that is the type of test the candidates want to take.

A Battalion Chief from the same Department stated that he believes high fidelity simulations provide a better assessment of how the candidates will be able to handle the event in real life. He also prefers high fidelity simulations because they are more similar to the training that the candidates receive.

The last person who was interviewed was a Captain who did not share the same opinions as the previous individuals. He stated that both high fidelity and low fidelity simulations are good tests. He believes it depends on the scenario and the rank that is being tested. The Lieutenant test he took involved a high fidelity simulation. This format was necessary because the Department wanted to test the candidates on their skills for saving victims and extinguishing fire. Whereas, the low fidelity simulation he took to become a Captain involved a building fire with over 25 people in the building. For this process, candidates were being tested on their ability to manage resources. Therefore, the low fidelity simulation worked well since it allowed for a high number of possible victims to be included in the scenario. This Captain believes that it is important to identify what the Department considers to be the most important competencies for the candidate to possess. Once that has been decided, the test developer should work with the Department to decide which type of simulation would best elicit those competencies.

Discussion

Our results indicated that there were no significant differences between candidates' scores on the high and low fidelity simulations. This finding did not support our first hypothesis. Then, we broke the overall scores down by competencies to determine if there were any significant differences at that level. The only competency which produced a significant result was reasoning and judgement/analytical ability. This competency involves the ability to analyze and evaluate, and the ability to define problems and devise solutions. Since fire personnel are more often trained outside using burn buildings, they have become used to analyzing the information around them and making decisions based on their analysis. It may be easier for fire personnel to define problems and devise solutions when they are able to use all of their senses. This helps them to obtain more information in a shorter period of time. Whereas, when candidates take a low fidelity simulation, they are in a new setting that does not have all the cues they are trained to evaluate in a real fire, and they are therefore unable to use all of their senses. They cannot smell the smoke or touch the equipment. Therefore, it may take them longer to define the problem and they may not be able to say everything they need to within the time limits of the simulation.

Our second hypothesis stated that candidates have more positive perceptions of high fidelity simulations than they do of low fidelity simulations. Only a small number of fire personnel were interviewed, but the majority of the opinions supported our hypothesis. We have been developing tests for over ten years. Candidates are constantly sharing their opinions with us about the tests they have taken. The majority of the candidates always express more negative perceptions of the low fidelity simulations.

Some studies have shown that negative perceptions of tests may reduce the candidate's desire to perform well and could lead to biased test scores (Arvey, Strickland, Drauden, & Martin, 1990). When candidates believe a test is fair and is an accurate representation of the job, they will be more likely to study and more motivated to perform well. Our study indicated that candidates do tend to

prefer high fidelity simulations, but this did not appear to affect their scores. Candidates received similar scores on both types of simulations.

More research needs to be conducted to examine the differences between high and low fidelity simulations. If low fidelity simulations do not elicit statistically different candidate scores from high fidelity simulations, then small departments with limited budgets may want to consider using them as part of their promotional processes.

Our test data consisted of scores from mostly white males, which prevented us from conducting additional analyses of the candidates. We believe it would be beneficial to examine whether there are any male/female differences between high and low fidelity simulations. It would also be valuable to examine whether there are any minority/non-minority differences between these simulations.

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