The Impact of Vocational Rehabilitation Services and Demographic Factors Towards the Successful Employment Outcomes Among Hard-of-Hearing Individuals

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Abstract

Hard-of-hearing (HoH) individuals are encouraged to utilize the numerous vocational rehabilitation services provided by the state-federal vocational rehabilitation (VR) services to enhance their quality of life and employment opportunities. Despite the importance of these services, limited studies have been conducted to identify the most meaningful VR services for the HoH population. This cross-sectional retrospective study on 24,983 evaluated consumers with and without successful employment outcome who were drawn from the U.S. Department of Education Rehabilitation Service Administration Case Service Report for the Fiscal Year 2014. The main goal of this study was to assess the impact of existing VR services in achieving a successful employment outcome. Additionally, we evaluated the effect of various demographic factors (gender, race and ethnicity, age, level of education, and secondary disability) on obtaining a successful employment outcome. Chi-square Automatic Interaction Detector (CHAID) and Logistic regression were used to analyze the data. Among all consumers, 69.7% of HoH consumers reached successful employment outcomes. The most significant VR services related to successful employment outcomes included assessment, diagnosis, and treatment of impairments, rehabilitation technology, vocational rehabilitation counseling and guidance, information and referral services, job placement assistance, job search assistance, transportation, maintenance, and other services.

Key Words: Hard-of-Hearing population, Employment outcomes, CHAID analysis, Logistic regression

1. Introduction

According to the National Center for Health Statistics (2015), approximately 37.2 million Americans live with hearing loss. About 2-3 of every 1,000 children in the U.S. are born with a hearing loss in one or both ears (Centers for Disease Control and Prevention, 2010). Data from the Committee on Accessible and Affordable Hearing Health Care for Adults (2016) as well as other sources, demonstrated that hearing loss may develop at any point during the life course, and the onset can be sudden from a variety of causes (e.g., trauma, infection, genetic syndromes, aging, or excessive noise exposure), where one or both ears can be affected problems (Hasson, Theorell, Wallén, Leineweber, & Canlon, 2011).

Due to a variety physical and psychosocial barriers, employment rates among the hard-of-hearing (HoH) individuals are lower than deaf individuals (Luft, Vierstra, Copeland, & Resh, 2009), and they earned lower than those in the general population (Walter & Dirmyer, 2013). Utilization of proper accommodations at the workplace may help reduce the employment barriers for HoH individuals, although the size and corporatization of the employer can significantly affect the provision of such accommodations (Bowe et al., 2005).

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As a consequence, HoH individuals have faced higher rates of unemployment and underemployment than people who are not hard-of-hearing (Danermark, 2005; Punch, 2016; Punch et al., 2004) throughout the past years.

The State-Federal Vocational Rehabilitation (VR) Program under the Department of Education is crucial in providing rehabilitation services that can help people with disabilities increase their employment rates (Huang, et al., 2016). Hard-of-hearing individuals can benefit from numerous vocational rehabilitation services to enhance their quality of life and employment opportunities. These include developing self-advocacy, obtaining information and referral services to community resources, and receiving job placement services, to name just a few options.

But despite the availability of important vocational rehabilitation services, earlier studies have found that individuals with hearing loss are less likely to seek assistance from VR professionals (Glass & Elliott, 1993; Jennings & Shaw, 2008). For instance, one early study has found that younger persons who are HoH had less chance of successful employment than older persons who are HoH (Lafitte, 1978) while a more recent study has found that an early onset of hearing loss is related to employment difficulties later (Hogan et al. 2009). Much later Hayward and Schmidt-Davis (2003) still found that only 15% out of 75,117 consumers with hearing loss had obtained job placement services between the years 1995 and 2000. Moreover, they discovered that consumers with hearing loss had received assistive devices (i.e. hearing aid) and other services relatively at a lower rate than the persons with other disabilities (Bradley et al., 2013).

In addition, compelling evidence exists to support the claim that there are significant disparities among gender, race, and ethnicity, level of education and impact from a secondary disability of the individuals in receiving the VR services (Boutin & Wilson, 2009; Nakaji 2014; Feist-Price,1995; Lafitte, 1978; Olney & Kennedy, 2002). Previous studies demonstrate slightly more women with hearing loss were served under the VR program, differences among genders who receive VR services create an interest since men are more likely to be HoH than women (Cruickshanks et al., 2015).

Previous studies also suggest access to VR services is more difficult for minorities than for service-seekers from non-minority groups (Wilson, 1999; Wilson & Senices, 2005; Wilson, Harley, McCormick, Jolivette, & Jackson, 2001; Wilson, Jackson, & Doughty, 1999). Somewhat unsurprisingly, Feist-Price (1995) found White individuals were accepted for rehabilitation services more often than Black or African Americans and were successfully rehabilitated more frequently than their Black or African American counterparts with higher-paid positions. Similarly, Moore (2001) has found that Hispanic and Latino consumers who are HoH possessed a lower rate of success in closures in VR service programs than non-Latinos who are HoH. Overall, minorities have had less success in becoming employed under the VR system when compared with White individuals or other racial/ethnic groups (Olney & Kennedy, 2002), possibly due to limited knowledge of rehabilitation services and its benefits and expressing a cultural mistrust of rehabilitation practitioners and potential employers (Moore, Ningning, Eugene-Cross, & Washington, 2016). And while education clearly plays a role in awareness of services and service-seeking, Boutin (2010) demonstrated that most consumers who are HoH with higher levels of education are still typically underemployed.

A large percentage of people served under the VR program with a documented secondary disability (Nakaji, 2014) exists, yet previous studies have not explored individuals who are HoH with a secondary disability regarding VR services and employment outcomes. One previous study by Hogan et al. (2009) found when the main condition was a hearing loss, 66.2% of these individuals were employed full-time, but when the main condition was not a hearing loss, only 46.4% were employed full-time.

Despite the rich literature of the studies on individuals with hearing loss, there is limited knowledge about issues relevant to rehabilitation counseling services related to individuals who are HoH regarding gender, race and ethnicity, age, level of education, and those with a secondary disability (Dammeyer & Chapman, 2017). As a result of these factors, identifying VR service areas that effectively address the needs of individuals who are HoH may help reduce concerning problems between VR services and employment outcomes for this population and maximize the possibility for a successful employment outcome.

Thus, the purpose of the present study was to evaluate the importance of VR services on reaching successful employment and identify the impact from various demographic factors like gender, race and ethnicity, age, level of education, and secondary disability among the hard-of-hearing individuals.

2. Materials and Methods

2.1 Data

We conducted a cross-sectional retrospective study using data from the RSA-911 service report for the year 2014. RSA-911 report includes information regarding demographic characteristics, type of disability, interventions or services provided, the reason for case closure, employment status, and sources of financial support (Dowden, Ethridge, & Brooks, 2016). The study included 24,983 consumers who were HoH, including both with and without a successful employment outcome. The dataset contains five consumers' demographic variables (Table 1) and the details of 28 VR services. All of them were categorical variables with age at application and level of education attained at closure being ordinal.

The study population consists of 50.2% female consumers, and the majority of the consumers were non-Hispanic White (76.7%). Most consumers, 45.1%, were ages 25-54, and 47.8% had no formal schooling or had a high school diploma/GED. The majority of consumers, 72.9%, did not have a secondary disability. According to Table 1, the top five VR services consumers who are HoH received were assessment (60.3%), vocational rehabilitation counseling and guidance (55.2%), rehabilitation technology (55%), diagnosis and treatment of impairments (51.4%), and information and referral services (17.4%). The five VR services consumers did not receive or least received were apprenticeship training (0%), reader services (0%), personal attendant services (0%), basic academic remedial or literacy training (0.2%), and customized employment services (0.4%).

The response variable for this study was the VR employment outcome, either successful or unsuccessful. According to the RSA-911 Reporting Manual (Rehabilitation Services Administration, 2013), a "successful rehabilitation" outcome as occurs after VR consumers have been accepted for services, developed and signed a written Individualized Plan for Employment, and obtained and maintained employment for a minimum of 90 days, and an "unsuccessful rehabilitation" outcome occurs after a consumer has been accepted for and provided with VR services, but was not able to make it to the point of obtaining and maintaining employment for at least 90 days. After receiving VR services, 69.7% of consumers reached successful employment outcomes.

2.2 Statistical methods

We used a Chi-square Automatic Interaction Detection (CHAID) (Kass, 1980) analysis to find the most influential VR services and the impact from demographic variables in finding successful employment outcomes among the hard-of-hearing consumers. CHAID is a decision tree model which helps in discovering the relationship between a set of predictor variables and the response variable. This model helps to break down the overall population

into homogeneous groups which share similar characteristics among each other. It builds a predictive decision tree model by determining the optimal ways to merge predictor variables to explain the relationship between the response and the predictor variables using chi-square tests. The process repeats to find the predictor variable on each leaf that is most significantly related to the response, branch by branch until no further predictors are found to have a statistically significant effect on the response. A Bonferroni adjusted p-value was utilized in order to account for multiple comparisons (Statistics Solutions, 2019).

Variable	Category	Count(n)	Percentage(%)
Gender	Male	n=12,435	49.80%
	Female	n=12,548	50.20%
Race and Ethnicity	Non-Hispanic White	n=19,155	76.70%
	Non-Hispanic Black	n=2,585	10.30%
	Hispanic	n=2,360	9.40%
	Other	n=883	3.50%
Age at Application	14-24	n=3,088	12.40%
	25-54	n=11,277	45.10%
	55+	n=10,618	42.50%
Level of Education Attained at Closure	No formal schooling, Elementary education (grades 1-8), Secondary education, no high school diploma (grades 9-12), Special education certificate of completion/diploma or in attendance, High school graduate or equivalency certificate (GED)	n=11,933	47.80%
	Vocational/Technical Certificate or License	n=962	3.90%
	Post-secondary education, no degree or certificate, Post-secondary academic degree, Associate degree, Bachelor's degree, Occupational credential beyond undergraduate degree work	n=10,537	42.20%
	Master's degree, Any degree above a Master's -e.g. Ph.D., Ed.D., J.D., Occupational credential beyond graduate degree work	n=1,551	6.20%

Secondary Disability	Mental	n=2,391	9.60%
	Physical	n=3,406	13.60%
	Other	n=962	3.90%
	None	n=18,224	72.90%
Assessment	No	n=9,930	39.70%
	Yes	n=15,053	60.30%
Diagnosis and Treatment of Impairments	No	n=11,636	46.60%
	Yes	n=12,848	51.40%
	Missing	n=499	2.00%
Vocational Rehabilitation Counseling and Guidance	No	n=9,964	39.90%
	Yes	n=13,796	55.20%
	Missing	n=1,223	4.90%
Graduate College or University Training	No	n=23,666	94.70%
	Yes	n=104	0.40%
	Missing	n=1,213	4.90%
Four-Year College or University Training	No	n=22,919	91.70%
	Yes	n=850	3.40%
	Missing	n=1,214	4.90%
Junior or Community College Training	No	n=23,432	93.80%
	Yes	n=361	1.40%
	Missing	n=1,190	4.80%
Occupational or Vocational Training	No	n=23,068	92.30%
	Yes	n=700	2.80%
	Missing	n=1,215	4.90%
On-the-job Training	No	n=23,581	94.40%
	Yes	n=156	0.60%
	Missing	n=1,246	5.00%
Apprenticeship Training	No	n=23,733	95.00%
	Yes	n=6	0.00%
	Missing	n=1,244	5.00%
Basic Academic Remedial or Literacy Training	No	n=23,684	94.80%
	Yes	n=58	0.20%
	Missing	n=1,241	5.00%
Job Readiness Training	No	n=23,062	92.30%
	Yes	n=679	2.70%
	Missing	n=1,242	5.00%

Disability-Related Skills Training	No	n=23,599	94.50%
	Yes	n=141	0.60%
	Missing	n=1,243	5.00%
Miscellaneous Training	No	n=23,132	92.60%
	Yes	n=564	2.30%
	Missing	n=1,287	5.20%
Job Search Assistance	No	n=21,759	87.10%
	Yes	n=2,033	8.10%
	Missing	n=1,191	4.80%
Job Placement Assistance	No	n=21,409	85.70%
	Yes	n=2,483	9.90%
	Missing	n=1,091	4.40%
On-the-job Supports-Short Term	No	n=22,965	91.90%
	Yes	n=776	3.10%
	Missing	n=1,242	5.00%
On-the-job Supports-Supported Employment	No	n=23,258	93.10%
	Yes	n=489	2.00%
	Missing	n=1,236	4.90%
Transportation	No	n=22,004	88.10%
	Yes	n=1,853	7.40%
	Missing	n=1,126	4.50%
Maintenance	No	n=22,411	89.70%
	Yes	n=1,378	5.50%
	Missing	n=1,194	4.80%
Rehabilitation Technology	No	n=10,880	43.50%
	Yes	n=13,749	55.00%
	Missing	n=354	1.40%
Reader Services	No	n=23,734	95.00%
	Yes	n=5	0.00%
	Missing	n=1,244	5.00%
Interpreter Services	No	n=22,952	91.90%
	Yes	n=876	3.50%
	Missing	n=1,155	4.60%
Personal Attendant Services	No	n=23,732	95.00%
	Yes	n=7	0.00%
	Missing	n=1,244	5.00%
Technical Assistance Services	No	n=23,580	94.40%
	Yes	n=165	0.70%
	Missing	n=1,238	5.00%

Information and Referral Services	No	n=19,495	78.00%
	Yes	n=4,340	17.40%
	Missing	n=1,148	4.60%
Benefits Counseling	No	n=23,555	94.30%
	Yes	n=192	0.80%
	Missing	n=1,236	4.90%
Customized Employment Services	No	n=23,690	94.80%
	Yes	n=108	0.40%
	Missing	n=1,185	4.70%
Other Services	No	n=20,652	82.70%
	Yes	n=3,230	12.90%
	Missing	n=1,101	4.40%
Type of Closure	Not Successful	n=7,578	30.30%
	Successful	n=17,405	69.70%

Table 1: Summary of the Study Population

Subsequently, a binary logistic regression analysis was performed to quantify the effect and identify the impact of each predictor towards a successful employment outcome. The stepwise model selection method was utilized based on the Akaike information criterion (Akaike, 1973), in developing the binary logistic regression models. Potential multicollinearity effects and were addressed successfully. Out of several candidates models with two-way interactions, the best model was selected, based on both statistical significance and personal expertise through the fieldwork experience. The goodness of fit tests was used including the Omnibus and the likelihood ratio tests to do the model validation.

The corresponding odds ratios were calculated by controlling for other factors. The odds ratio identifies the likelihood of a successful employment outcome for individuals with certain consumer characteristics and vocational rehabilitation services compared to those who did not. Statistical analyses were conducted using R version 3.6.1. All statistical tests were 2 -sided and has a significance (alpha) level of 0.05.

3. Results

Similar to the population with hearing impairments (Boutin, 2010), non-Hispanic whites (76.7%) comprised the largest group of HoH consumers in this study served in the VR program followed by non-Hispanic Black HoH consumers (10.4%), Hispanic consumers who are hard-of-hearing (9.5%), and American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, or Multiracial individuals made up the least amount of consumers (3.5%).

1.)	If Rehabilitation Technology = 0 and Diagnosis and Treatment of Impairments = 0 and Job Placement Assistance is either 0 or 2 and Maintenance is either 0 or 2, and Other Services is either 0 or 2 and Secondary Disability = 4 and Age at Application=1, then the predicted outcome for this category would be 0, not successfully employed. There were 601 subjects in this category, and the error rate was 18.64%..

2.)	If Rehabilitation Technology = 0 and Diagnosis and Treatment of Impairments = 0 and Job Placement Assistance is either 0 or 2, and Maintenance is either 0 or 2, and Other Services is either 0 or 2 and Secondary Disability = 4 and Age at Application is either 2 or 3, and Level of Education Attained at Closure is either 1 or 3, then the predicted outcome for this category would be 0, not successfully employed. There were 1,939 subjects in this category, and the error rate was 30.17%.
3.)	If Rehabilitation Technology = 0 and Diagnosis and Treatment of Impairments = 0 and Job Placement Assistance is either 0 or 2, and Maintenance is either 0 or 2, and Other Services is either 0 or 2, and Secondary Disability = 4 and Age at Application is either 2 or 3, and Level of Education is either 2 or 4, then the predicted outcome for this category would be0, not successfully employed. There were 220 subjects in this category, and the error rate was 18.64%.
4.)	If Rehabilitation Technology = 0 and Diagnosis and Treatment of Impairments = 0 and Job Placement Assistance are either 0 or 2 and Maintenance is either 0 or 2, and Other Services is either 0 or 2, and Secondary Disability is either 1 or 3, then the predicted outcome for this category would be 0, not successfully employed. There were 735 subjects in this category, and the error rate was 18.91%.
5.)	If Rehabilitation Technology = 0 and Diagnosis and Treatment of Impairments = 0 and Job Placement Assistance are either 0 or 2 and Maintenance is either 0 or 2, and Other Services is either 0 or 2 and Secondary Disability=2, then the predicted outcome for this category would be 0, not successfully employed. There were 782 subjects in this category, and the error rate was 14.96%.
6.)	If Rehabilitation Technology = 0 and Diagnosis and Treatment of Impairments = 0 and Job Placement Assistance is either 0 or 2 and Maintenance is either 0 or 2, and Other Services is 1, then the predicted outcome for this category would be 1, successfully employed. There were 185 subjects in this category, and the error rate was 44.32%.
7.)	If Rehabilitation Technology = 0 and Diagnosis and Treatment of Impairments = 0 and Job Placement Assistance is either 0 or 2 and Maintenance is 1, then the predicted outcome for this category would be 1, successfully employed. There were 131 subjects in this category, and the error rate was 26.72%.
8.)	If Rehabilitation Technology=0 and Diagnosis and Treatment of Impairments = 0 and Job Placement Assistance = 1, then the predicted outcome for this category would be 1, successfully employed. There were 419 subjects in this category, and the error rate was 1.26%.
9.)	If Rehabilitation Technology = 0 and Diagnosis and Treatment of Impairments is either 1 or 2 and Age at Application = 1, then the predicted outcome for this category would be 1, successfully employed. There were 419 subjects in this category, and the error rate was 39.86%.
10.)	If Rehabilitation Technology = 0 and Diagnosis and Treatment of Impairments is either 1 or 2 and Age at Application = 2, then the predicted outcome for this category would be 1, successfully employed. There were 1,742 subjects in this category, and the error rate was 29.22%.
11.)	If Rehabilitation Technology = 0 and Diagnosis and Treatment of Impairments is either 1 or 2 and Age at Application = 3, then the predicted outcome for this category would be 1, successfully employed. There were 1,576 subjects in this category, and the error rate was 20.05%.

12.)	If Rehabilitation Technology = 1 and Transportation=0 and Secondary Disability = 4 and Age at Application=1, then the predicted outcome for this category would be 1, successfully employed. There were 425 subjects in this category, and the error rate was 23.06%.
13.)	If Rehabilitation Technology = 1 and Transportation = 0 and Secondary Disability = 4 and Age at Application is either 2 or 3, and Job Search Assistance is either 0 or 2, and Job Placement Assistance is either 0 or 2, and Interpreter Services is either 0 or 2, and Diagnosis and Treatment of Impairments is either 0 or 2 and Maintenance is either 0 or 2 and Race = 1, then the predicted outcome for this category would be 1, successfully employed. There were 2,714 subjects in this category, and the error rate was 3.8%.
14.)	If Rehabilitation Technology = 1 and Transportation = 0 and Secondary Disability = 4 and Age at Application is either 2 or 3 and Job Search Assistance is either 0 or 2, and Job Placement Assistance is either 0 or 2, and Interpreter Services is either 0 or 2, and Diagnosis and Treatment of Impairments is either 0 or 2 and Maintenance is either 0 or 2 and Race is either 2 or 3 or 4, then the predicted outcome for this category would be 1, successfully employed. There were 401 subjects in this category, and the error rate was 7.23%.
15.)	If Rehabilitation Technology = 1 and Transportation = 0 and Secondary Disability = 4 and Age at Application is either 2 or 3 and Job Search Assistance is either 0 or 2, and Job Placement Assistance is either 0 or 2, and Interpreter Services is either 0 or 2, and Diagnosis and Treatment of Impairments is either 0 or 2 and Maintenance = 1, then the predicted outcome for this category would be 1, successfully employed. There were 54 subjects in this category, and the error rate was 16.67%.
16.)	If Rehabilitation Technology = 1 and Transportation = 0 and Secondary Disability = 4 and Age at Application is either 2 or 3, and Job Search Assistance is either 0 or 2, and Job Placement Assistance is either 0 or 2, and Interpreter Services is either 0 or 2, and Diagnosis and Treatment of Impairments = 1 and Vocational Rehabilitation Counseling and Guidance is either 0 or 2, then the predicted outcome for this category would be 1, successfully employed. There were 615 subjects in this category, and the error rate was 11.38%.
17.)	If Rehabilitation Technology = 1 and Transportation = 0 and Secondary Disability = 4 and Age at Application is either 2 or 3, and Job Search Assistance is either 0 or 2, and Job Placement Assistance is either 0 or 2, and Interpreter Services is either 0 or 2 and Diagnosis and Treatment of Impairments = 1 and Vocational Rehabilitation Counseling and Guidance = 1 and Race is either 1 or 3 and Information and Referral Services is either 0 or 2, then the predicted outcome for this category would be 1, successfully employed. There were 2,003 subjects in this category, and the error rate was 6.29%.
18.)	If Rehabilitation Technology = 1 and Transportation=0 and Secondary Disability = 4 and Age at Application is either 2 or 3, and Job Search Assistance is either 0 or 2, and Job Placement Assistance is either 0 or 2, and Interpreter Services is either 0 or 2 and Diagnosis and Treatment of Impairments=1 and Vocational Rehabilitation Counseling and Guidance = 1 and Race is either 1 or 3 and Information and Referral Services=1, then the predicted outcome for this category would be 1, successfully employed. There were 784 subjects in this category, and the error rate was 4.21%.

19.)	If Rehabilitation Technology = 1 and Transportation = 0 and Secondary Disability = 4 and Age at Application is either 2 or 3, and Job Search Assistance is either 0 or 2, and Job Placement Assistance is either 0 or 2, and Interpreter Services is either 0 or 2 and Diagnosis and Treatment of Impairments = 1 and Vocational Rehabilitation Counseling and Guidance = 1 and Race is either 2 or 4, then the predicted outcome for this category would be 1, successfully employed. There were 253 subjects in this category, and the error rate was 11.86%.
20.)	If Rehabilitation Technology = 1 and Transportation = 0 and Secondary Disability = 4 and Age at Application is either 2 or 3, and Job Search Assistance is either 0 or 2, and Job Placement Assistance is either 0 or 2, and Interpreter Services = 1, then the predicted outcome for this category would be 1, successfully employed. There were 80 subjects in this category, and the error rate was 21.25%.
21.)	If Rehabilitation Technology = 1 and Transportation = 0 and Secondary Disability = 4 and Age at Application is either 2 or 3, and Job Search Assistance is either 0 or 2, and Job Placement Assistance = 1, then the predicted employment outcome would be 1, successfully employed. There were 270 subjects in this category, and the error rate was 14.44%.
22.)	If Rehabilitation Technology = 1 and Transportation = 0 and Secondary Disability = 4 and Age at Application is either 2 or 3, and Job Search Assistance = 1, then the predicted employment outcome would be 1, successfully employed. There were 224 subjects in this category, and the error rate was 25%.
23.)	If Rehabilitation Technology = 1 and Transportation = 0 and Secondary Disability = 1, then the predicted employment outcome would be 1, successfully employed. There were 492 subjects in this category, and the error rate was 21.95%.
24.)	If Rehabilitation Technology = 1 and Transportation = 0 and Secondary Disability = 2, then the predicted employment outcome would be 1, successfully employed. There were 1,045 subjects in this category, and the error rate was 16.36%.
25.)	If Rehabilitation Technology = 1 and Transportation = 0 and Secondary Disability = 3, then the predicted employment outcome would be 1, successfully employed. There were 340 subjects in this category, and the error rate was 11.47%.
26.)	If Rehabilitation Technology = 1 and Transportation is either 1 or 2, then the predicted employment outcome would be 1, successfully employed. There were 1,260 subjects in this category, and the error rate was 31.98%.
27.)	If Rehabilitation Technology = 2, then the predicted employment outcome would be 0, not successfully employed. There were 278 subjects in this category, and the error rate was 26.62%.

Table 2: CHAID Interactions [1]

Through the univariate analysis performed using Chi-square tests and Fisher's exact tests (when the cell counts are small), it was found that there exists a significant association between the employment outcome with each predictor variable except gender (p-value

[1]Footnote: The code significance each variable were: gender: male=male and female=female, race and ethnicity: Non-Hispanic White=1, Non-Hispanic Black=2, Hispanic=3, and Other=4, age at application: 14-24=1, 25-54=2, 55+=3, level of education attained at closure: no formal schooling or had a high school diploma/GED=1, vocational/technical certificate or license=2, post-secondary education to occupational credential beyond undergraduate degree work=3, and master's degree to occupational credential beyond graduate degree work=4, secondary disability: mental=1, physical=2, other=3, and none=4, VR services: not received=0, received=1, and missing=2, and employment outcome: not successful=0, successful=1, and missing=2.

.084).

A CHAID model was developed to identify the factors with the greatest impact on the likelihood of response. The first sets of splits of the final CHAID model, hence the most significant predictor variables towards the response, was whether or not several vocational rehabilitation services were utilized by the consumers. We have listed down some of the interesting interactions that we have found through our analysis. The rest of the interactions are listed in Table 2.

- HoH consumers with any level of education attained at closure from any age groups that only received diagnosis and treatment of impairments as a VR service were able to achieve a successful employment outcome.
- Regardless of the race and ethnicity, for consumers ages 25-54 or 55+, when they received diagnosis and treatment of impairments, vocational rehabilitation counseling and guidance, information and referral services, and rehabilitation technology, successful employment outcome was guaranteed.
- If consumers had a mental, physical, or other secondary disability and only received rehabilitation technology as a VR service, they were still predicted to achieve a successful employment outcome.
- If consumers did not receive any VR services, an unsuccessful employment outcome was predicted.

Additionally, we were able to score the relative importance of the explanatory variable in the CHAID based on mean decrease in accuracy

a) rehabilitation technology (0.264)
b) diagnosis and treatment of impairments (0.090)
c) job placement assistance (0.016)
d) transportation (0.016)
e) secondary disability (0.010)
f) age at application (0.010)
g) maintenance (0.006)
h) other services (0.005)
i) job search assistance (0.003)
j) race and ethnicity (0.001)
k) vocational rehabilitation counseling and guidance (0.001)
l) level of education attained at closure (0.001)
m) interpreter services (<0.001)
n) information and referral services (<0.001)

The most significant VR services identified through the likelihood ratio test after controlling for other variables are as follows: maintenance (p-value 1.393e-05), assessment (p-value 2.2e-16), on-the-job supports-supported employment (p-value 2.2e-16), other services (p-value 2.898e-07), transportation (p-value 3.293e-07), diagnosis and treatment of impairments (p-value 0.0000), vocational rehabilitation counseling and guidance (p-value 0.0000), job search assistance (p-value 0.0000), job placement assistance (p-value 0.0000), information and referral services (p-value 0.0005), rehabilitation technology (p-value 0.0000), job readiness training (p-value 0.0010), miscellaneous training (p-value 0.0034), interpreter services (p-value 0.0166), benefits counseling (p-value 0.0298), and junior or community college training (p-value 0.0793). The impact of demographic predictors include, level of education attained at closure (p-value 0.0000), secondary disability (p-value 0.0000), race and ethnicity (p-value 0.0000), and age at application (p-value 0.0000).

Moreover, the following interactions were found to be significant regarding successful outcomes from the binary logistic regression model based on the likelihood ratio test: secondary disability and diagnosis and treatment of impairments (p-value 4.68e-7), secondary disability and job placement assistance (p-value 0.0006), secondary disability and age at application (p-value 1.366e-05), level of education attained at closure and vocational rehabilitation counseling and guidance (p-value 4.438e-06), level of education attained at closure and rehabilitation technology (p-value 0.0006), level of education attained at closure and age at application (p-value 2.2e-16), diagnosis and treatment of impairments and age at application (p-value 0.0294), job search assistance and age at application (p-value 6.03e-12), job placement assistance and age at application (p-value 0.0004), rehabilitation technology and age at application (p-value 1.357e-07), and rehabilitation technology and race and ethnicity (p-value 0.0018).

For a HoH consumer who had a level of education attained at closure of master's degree or higher, the estimated odds of achieving a successful employment outcome is 11.71 (95% CI 3.21-42.66) times as great as the estimated odds for a consumer who had no formal schooling up to a high school graduate or equivalency certificate (GED) after controlling for other factors in the model (Table 3). When an HoH consumer had received rehabilitation technology as a VR service, the estimated odds of achieving a successful employment outcome is 4.55 (95% CI 3.51-5.89) times the estimated odds for a consumer who had not receive this VR service after controlling for other factors in the model. When an HoH consumer had received diagnosis and treatment of impairments as a VR service, the estimated odds of achieving a successful employment outcome is 3.15 (95% CI 2.51-3.95) times the estimated odds for a consumer who had not receive this VR service.

Variable	Odds Ratio	Lower	Upper
Level of Education Attained at Closure2	2.0438	1.1125	3.7546
Level of Education Attained at Closure3	2.2190	1.7664	2.7875
Level of Education Attained at Closure4	11.7085	3.2134	42.661
Secondary Disability1	0.8055	6.1492	1.0552
Secondary Disability2	0.6927	4.7048	1.0198
Secondary Disability3	0.9015	5.7233	1.4200
Assessment1	0.6799	6.2354	7.4145
Diagnosis and Treatment of Impairments1	3.1515	2.5147	3.9495
Diagnosis and Treatment of Impairments2	3.9667	1.3443	1.1705
Vocational Rehabilitation Counseling and Guidance1	1.4099	1.2470	1.5941
Vocational Rehabilitation Counseling and Guidance2	0.0887	1.4826	5.3063
Information and Referral Services1	0.9779	8.6882	1.1006
Information and Referral Services2	0.2734	1.3794	5.4201

Junior or Community College Training1	0.7012	5.0281	9.7792
Junior or Community College Training2	0.4769	1.8380	1.2374
Job Readiness Training1	0.6949	5.5019	8.7758
Job Readiness Training2	41.3634	9.6182	1.7789
Job Search Assistance1	2.0077	1.4696	2.7428
Job Search Assistance2	0.7009	1.5303	3.2097
Job Placement Assistance1	2.7433	1.9482	3.8628
Job Placement Assistance2	0.4432	1.1994	1.6380
Transportation1	0.7187	6.0965	8.4717
Transportation2	1.9621	1.1560	3.3303
Maintenance1	1.5704	1.2975	1.9006
Maintenance2	1.2545	6.0609	2.5965
Rehabilitation Technology1	4.5493	3.5122	5.8926
Rehabilitation Technology2	0.8248	2.5933	2.6230
Other Services1	1.4123	1.2354	1.6145
Other Services2	0.8499	5.2749	1.3695
Miscellaneous Training1	0.6743	5.2794	8.6122
Miscellaneous Training2	1.3929	7.1479	2.7143
On-the-job Supports-Short Term1	5.5831	4.2409	7.3501
On-the-job Supports-Short Term2	2.4185	1.7767	3.2922
On-the-job Supports-Supported Employment1	6.3910	4.4049	9.2727
On-the-job Supports-Supported Employment2	0.0140	1.0726	1.8210
Benefits Counseling1	0.7232	4.7279	1.1063
Benefits Counseling2	17.7254	4.7401	6.6283
Interpreter Services1	0.7824	6.3299	9.6709
Interpreter Services2	1.3727	7.2529	2.5980
Race and Ethnicity2	0.6460	5.5531	7.5146
Race and Ethnicity3	0.7985	6.7298	9.4753
Race and Ethnicity4	0.8528	6.7971	1.0699
Age at Application2	3.08011	2.4921	3.8069
Age at Application3	3.8530	3.0966	4.7941
Secondary Disability1: Diagnosis and Treatment of Impairments1	0.5329	4.1153	6.8995
Secondary Disability2: Diagnosis and Treatment of Impairments1	0.8128	6.5167	1.0139
Secondary Disability3: Diagnosis and Treatment of Impairments1	1.0874	7.2510	1.6307
Secondary Disability1: Diagnosis and Treatment of Impairments2	0.9041	3.1707	2.5778
Secondary Disability2: Diagnosis and Treatment of Impairments2	4.3989	1.7905	1.0807
Secondary Disability3: Diagnosis and Treatment of Impairments2	1.0420	1.9823	5.4778
Secondary Disability1: Job Placement Assistance1	2.1763	1.5302	3.0952
Secondary Disability2: Job Placement Assistance1	1.3593	9.5451	1.9357
Secondary Disability3: Job Placement Assistance1	0.7497	4.1613	1.3507
Secondary Disability1: Job Placement Assistance2	0.8697	4.8232	1.5681
Secondary Disability2: Job Placement Assistance2	0.8803	4.9349	1.5703
Secondary Disability3: Job Placement Assistance2	0.7342	3.6019	1.4966
Secondary Disability1: Age at Application2	0.4791	3.5418	6.4813

Secondary Disability2: Age at Application2	0.5463	3.6172	8.2514
Secondary Disability3: Age at Application2	0.8978	5.3739	1.4998
Secondary Disability1: Age at Application3	0.7561	5.2388	1.0912
Secondary Disability2: Age at Application3	0.6467	4.2782	9.7771
Secondary Disability3: Age at Application3	0.6949	4.0808	1.1831
Level of Education Attained at Closure2: Vocational Rehabilitation Counseling and Guidance1	2.2703	1.4301	3.6041
Level of Education Attained at Closure3: Vocational Rehabilitation Counseling and Guidance1	1.11	9.44	1.3052
Level of Education Attained at Closure4: Vocational Rehabilitation Counseling and Guidance1	2.3565	1.632	3.4025
Level of Education Attained at Closure2: Vocational Rehabilitation Counseling and Guidance2	2.1683	9.9182	4.7402
Level of Education Attained at Closure3: Vocational Rehabilitation Counseling and Guidance2	1.5456	1.0034	2.3808
Level of Education Attained at Closure4: Vocational Rehabilitation Counseling and Guidance2	1.6331	6.8027	3.9203
Level of Education Attained at Closure2: Rehabilitation Technology1	1.1129	6.8473	1.8089
Level of Education Attained at Closure3: Rehabilitation Technology1	0.8322	7.0165	9.87
Level of Education Attained at Closure4: Rehabilitation Technology1	1.9659	1.2969	2.979
Level of Education Attained at Closure2: Rehabilitation Technology2	1.3615	3.0283	6.1208
Level of Education Attained at Closure3: Rehabilitation Technology2	1.5591	6.775	3.5877
Level of Education Attained at Closure4: Rehabilitation Technology2	0.8114	9.6977	6.7893
Level of Education Attained at Closure2: Age at Application2	0.3762	2.055	6.8853
Level of Education Attained at Closure3: Age at Application2	0.4681	3.6962	5.9274
Level of Education Attained at Closure4: Age at Application2	0.0799	2.1538	2.9618
Level of Education Attained at Closure2: Age at Application3	0.2741	1.4295	5.2575
Level of Education Attained at Closure3: Age at Application3	0.362	2.8371	4.6202
Level of Education Attained at Closure4: Age at Application3	0.0401	1.0891	1.4778
Diagnosis and Treatment of Impairments1: Age at Application2	0.8322	6.5182	1.0625
Diagnosis and Treatment of Impairments2: Age at Application2	0.5898	1.8266	1.9045
Diagnosis and Treatment of Impairments1: Age at Application3	1.0455	8.1125	1.3474
Diagnosis and Treatment of Impairments2: Age at Application3	0.4145	1.2539	1.3702
Job Search Assistance1: Age at Application2	0.4286	2.9597	6.2063

Job Search Assistance2: Age at Application2	1.8098	4.139	7.9138
Job Search Assistance1: Age at Application3	0.1988	1.2947	3.0518
Job Search Assistance2: Age at Application3	1.7959	3.4194	9.4325
Job Placement Assistance1: Age at Application2	0.5535	3.76	8.1488
Job Placement Assistance2: Age at Application2	0.3619	7.7861	1.6822
Job Placement Assistance1: Age at Application3	0.3696	2.3905	5.7136
Job Placement Assistance2: Age at Application3	0.2783	4.9729	1.5576
Rehabilitation Technology1: Age at Application2	1.9399	1.4907	2.5245
Rehabilitation Technology2: Age at Application2	0.5762	1.7029	1.9493
Rehabilitation Technology1: Age at Application3	2.2489	1.7155	2.9481
Rehabilitation Technology2: Age at Application3	0.6948	1.9157	2.5198
Rehabilitation Technology1: Race and Ethnicity2	0.8566	6.6718	1.0997
Rehabilitation Technology2: Race and Ethnicity2	1.3251	5.0438	3.481
Rehabilitation Technology1: Race and Ethnicity3	0.6517	5.015	8.47
Rehabilitation Technology2: Race and Ethnicity3	0.4795	1.3548	1.6973
Rehabilitation Technology1: Race and Ethnicity4	0.5266	3.5989	7.7042
Rehabilitation Technology2: Race and Ethnicity4	1.3373	2.1083	8.4824

Table 3: Estimated Odds Ratio and 95% Confidence Intervals [2]

The following odds ratios unveil some hidden contributions of different VR services towards the successful employment outcome that have not been commonly explored in previous literature. If an HoH consumer had received on-the-job supports-supported employment as a VR service, the estimated odds of achieving a successful employment outcome is 6.39 (95% CI 4.40-9.27) times the estimated odds for a consumer who did not receive this VR service after controlling for other factors in the model. When a consumer who is hard-of-hearing received on-the-job supports-short term as a VR service, the estimated odds of achieving a successful employment outcome is 5.58 (95% CI 4.24-7.35) times the estimated odds for a consumer who did not receive this VR service after controlling for other factors in the model.

4. Discussion

As one of the relatively few studies focused on the HoH consumer population served by the State-Federal VR service program, we anticipate our findings may open new insight into the field of service management. Our results confirmed that the minority HoH groups continue to receive VR services at a lesser rate than non-Hispanic White HoH. This deserves the attention of the VR personnel in finding more effective, culturally responsive strategies for serving this community. For example, more meaningful strategies might include addressing the previously identified barriers like limited knowledge of VR services and cultural mistrust of rehabilitation professionals (Moore et al., 2016). Other areas of improvement may be found in addressing problems associated with transportation and possible language barriers among American Indians (Martin et al., 1988; Saravanabhavan, 1991). Further strategies could better respond to the more collectivist values of group harmony and familial pride among Asian Americans (Ghosh & Fouad, 2016; Millner & Kim, 2017; Sue & Sue, 2012).

[2]Footnote: The reference (base) levels for each explanatory variable were: gender="male", race and ethnicity="Non-Hispanic White", age at application="14-24", level of education attained at closure="no formal schooling or had a high school diploma/GED", secondary disability= "none", and all VR services="did not receive VR service".

As expected based on prior research results (Bainbridge & Ramachandran, 2014), non-Hispanic White HoH consumers received rehabilitation technology at a higher rate (57.0%) than all other groups. However, significant results were found between the rates in which each group received these VR services, particularly among Hispanic consumers. However, it was surprising to find this group received assessment (76%), diagnosis and treatment of impairments (63.5%), vocational rehabilitation counseling and guidance (62.6%), and information and referral services (29.4%) at higher rates than all other groups. Hispanic consumers were also at a close rate (55.9%) to Non-Hispanic White consumers (57%) when receiving rehabilitation technology.

The majority of HoH consumers were from the prime working-age group, 25-54, (45.1%) followed by consumers who were in the older age group, 55+, (42.5%). While it is significant how consumers in the age group 55+ were found to be assisted at a higher rate in the VR program than previous research indicates, it is also significant how consumers in the transition age group continue to be under-served, indicating further attention needed to HoH consumers in the transition age group.

The majority of consumers in this study (72.9%) did not have a secondary disability. A noteworthy finding among HoH consumers with secondary disabilities of other sensory/communicative impairments was how these consumers utilized the majority of the top VR services more frequently than consumers with a physical, mental, or no secondary disability did. Consumers who had a vocational/technical certificate or license had received assessment (70.1%), diagnosis and treatment and impairments (59.3%), vocational rehabilitation counseling and guidance (61.1%), rehabilitation technology (60.4%), and information and referral services (24.7%) at higher rates than all other consumers with other levels of education did. The HoH consumers looking into post-secondary opportunities may benefit from discussing career exploration with VR counselors to assess personal levels of motivation, interest in exploring higher education, and self-advocacy skills, as these can play an important role in pursuing higher education (Albertini, Kelly, & Matchett, 2011; Hyde, Nikolaraizi, Powell, & Stinson, 2016).

In terms of gender, there were no statistically noteworthy differences found among the top VR services received, which included assessment, diagnosis, and treatment of impairments, vocational rehabilitation counseling and guidance, rehabilitation technology, and information and referral services. On the other hand, notable findings were found between males and females who are hard-of-hearing regarding females utilizing certain VR services at slightly higher rates than males.

Overall, the most significant VR services that contributed towards successful employment outcomes include assessment, diagnosis, and treatment of impairments, rehabilitation technology, vocational rehabilitation counseling and guidance, information and referral services, job placement assistance, job search assistance, transportation, maintenance, and other services. These VR services turned out to be as expected and similar to previous research.

There were also several interesting combinations of demographic variables and VR services found which predicted successful employment outcomes among HoH consumers. We encourage administrative personnel in the VR program to examine these relationships in providing a better service which is well adjusted to the majority of HoH consumers served by each service centers. These include focusing on providing the VR service; rehabilitation technology to HoH individuals in any ethnic group who is in between the ages, 25-54 or 55+, to achieve a successful employment outcome. In fact, if those individuals can be served by a combination of VR services; diagnosis and treatment of impairments, vocational rehabilitation counseling and guidance, and rehabilitation technology, this will help them in achieving their employment outcomes. For the HoH consumers who are in

the transition-age group 14-24, if they were served by both VR services; rehabilitation technology and diagnosis & treatment of impairments, then they are highly likely to get a successful employment outcome. VR counselors are encouraged to focus on providing a better service in rehabilitation technology, specifically for HoH individuals with a secondary disability who, if they had received rehabilitation technology as a VR service, would have been much more likely to have a successful outcome.

In closing, we would like to mention about a few limitations in our study. Although we had a sample size of 24,983, there were several predictor categories that didn't have more than five consumers. Second, only data from FY 2014 was explored, so if results are compared to previous or future years, they may differ. Third, due to low population numbers for American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, or Multiracial groups, these consumers were not analyzed individually, and instead they were generalized.

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