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A Quantitative Analysis of the Differing Perceptions of Geography by Visually and Non-Visually Impaired Students

Christopher D. Murr
Texas State University-San Marcos

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Abstract

Visually impaired students encounter numerous challenges to learning and using geography due to its highly spatial nature. While research is being conducted in areas such as technology to improve access, not much is known as to the degree to which visually impaired and non-visually impaired populations differently perceive their ability to engage successfully in geography course and major work. Such an understanding is essential to identifying and overcoming barriers to the effective conveyance of geographic knowledge to this special needs population. This study using the Mann-Whitney test demonstrates that there is a statistically significant difference between sight and non-sight impaired students' (matriculated at North American colleges and universities) perceived abilities to be successful in the study of geography relative to other visual and non-visual disciplines. The data support a lack of perceived success and thus, likely engagement among the visually impaired in collegiate geography. Such a scenario poses a challenge to the discipline in terms of ensuring diverse thought and solutions regarding the world's geospatial problems.

Key Words: Geography, learning, visually impaired, geography education

Introduction

The purpose of this research is to provide an understanding of the perceptions that visually impaired students have of their ability to engage successfully in geographic course and major work at the postsecondary level. The primary objective of this paper is to demonstrate whether a statistically significant variation is present between the visually impaired and their sighted peers regarding their expected performance in geography studies. If such a significant difference exists, and it is one in which the sight impaired perceive greater difficulty, the likely involvement of the visually impaired in classroom geography would be at a comparatively low level. Thus, it is not conducive to diverse geo-spatial thought within the discipline.

Geography educators face unique challenges to the effective conveyance of geographical information to the visually impaired. This difficulty is the result of the discipline's very spatial nature and the predominant use of visual means to convey geo-spatial knowledge. As Golledge (1997) asserts, "geography is a spatial science, and vision is the spatial sense *par excellence*" (p. 207).

A number of geographers, psychologists, and other researchers have put forth the call for greater empirical investigation relative to geography and the disabled (Golledge, 1993; Gleeson, 1996; Hardwick, 1997; Kitchin et al., 1997; Siekierska et al., 2003; Golledge, 2004). Researchers may pursue many avenues to better illuminate the solutions to the effective transmission of geographic information to those with no or limited vision. For "while we do not know a great deal about how the *blind* perceive space, we do know that *blind* people know less about geographical configuration and the location of objects in space than do sighted people" (Siekierska et al., 2003, p. 480).

This study examines students matriculated at two- and four-year institutions of higher education in North America. The focus on this range of the education spectrum is, in part, driven by the lack of geography education research conducted at the postsecondary level. Brown (1997), for instance, proffers that geography education research has, for the main part, only "involved the K-12 classroom" (p. 239). Likewise, Hill (1997) asserts that "research in geography has overwhelmingly emphasized pre-collegiate education" (p. 171). By researching and establishing a statistically significant variation between the sight and non-sight impaired relative to their perceptions of learning geography at colleges and universities, a foundation can be constructed upon which further research employing stigmatization and other theories can be built. In order to investigate such differences, it is crucial to explore the various learning theories of the visually impaired that have been developed.

Literature Review

Geographers and others have made the case for greater and continued research in the area of geography and the disabled (Golledge, 1993; Gleeson, 1996; Hardwick, 1997; Kitchin et al., 1997; Siekierska et al., 2003; Golledge, 2004). Though research is progressing in this area, there is a void in the literature regarding both quantitative and qualitative studies on the varying perceptions the visually and non-visually impaired have in terms of their perceived ability to successfully undertake the study of geography at the college level. In conducting such research, it is important to understand the general theories regarding the spatial cognitive abilities of the visually impaired because underlying this study is the assumption that this population can appreciate and benefit from such knowledge.

The spatial cognitive abilities of the visually impaired and blind have been under investigation for some time. "Psychologists since the 1920s have engaged in debate concerning sight and spatial ability. Much of this argument concerned the premise that without sight, spatial knowledge and spatial ability would be both diminished and impoverished" (Kitchin et al., 1997, p. 228). As with any debate, there are varying positions on the ability of the visually impaired, and in particular the congenitally blind, to perceive and understand space—as well as the relationships and patterns of phenomena within it—and issues regarding change of scale. These perspectives have been classified into three theoretical categories—deficiency, inefficiency, and difference.

Deficiency theory (Fletcher, 1980; Golledge, 1993; Ungar et al., 1996) builds upon the axiom that the congenitally blind do not have the capacity to comprehend spatially due to their lack of vision and results in "limited" experiencing and interpreting of their environment. The theory also asserts:

> "that even some adventitiously blind individuals will not have had the opportunity to develop full spatial relational comprehension and may also be regarded as being deficient in terms of the cognitive skills required to produce and use complex spatial representations" (Golledge, 1993, p. 71).

This stance is evidenced in the research of Rieser and colleagues (1986) and Dodds and colleagues (1982). The latter study demonstrated, using 11 year old congenitally (at birth) and adventitiously (due to an event after birth) blind children as test subjects, that vision plays a significant role in both coding and decoding spatial data and that the lack of visual acuity poses significant challenges to spatial comprehension.

A second framework is *inefficiency theory* (Fletcher, 1980; Golledge, 1993; Ungar et al., 1996). Simply put, this theory advocates that those with visual impairments can comprehend spatially—both two and three dimensionally. Such individuals, however, do not have the same degree of comprehension and cognitive manipulation (e.g., rotation) of spatial data due to the non-visual system (i.e., haptic and aural) nature by which the visually impaired gather and encode information about small and large-scale space (Spencer et al., 1989).

Finally, *difference theory* (Fletcher, 1980; Golledge, 1993; Ungar et al., 1996) recognizes that while there may be variation in the way the visually impaired acquire, encode, and organize spatial information, some researchers, as early as Cratty (1966), have demonstrated that the visually impaired have a spatial capacity comparable with that of the sighted. The work of Passini and Proulx (1988), for example, support this theoretical context. Their study involved 15 congenitally blind and 15 sighted individuals. The findings suggest similar abilities between both groups to wayfind and later represent the relevant spatial data via sketch maps. Difference theory acknowledges that:

> "the full range of spatial abilities and relational skills are present in normally sighted, adventitiously blind, congenitally blind, or otherwise visually impaired individuals, but the extent to which sight is present, may introduce substantial quantitative and qualitative differences in the ability of individuals to perform spatial tasks" (Golledge, 1993, p. 72).

In other words, the manner in which a visually impaired person accesses spatial information affects his or her ability to constructively use it (e.g., wayfinding).

Operating within the theoretical difference construct, researchers are developing technologies for the visually impaired to better access and use geographic information. This work will enhance opportunities for the sight impaired to become more knowledgeable about the nature of space, both in an applied and theoretical context, and thus, more integrated within society. Just as important to removing hindrances to the accessibility of one's immediate environment, it is critical to understand what, if any, significant differences exist between the visually impaired and non-visually impaired regarding their perceived abilities to successfully engage in the learning of "classroom" geography. With such data, an informed case can be proffered for more incisive research into this area and for developing the educational tools and approaches to more fully engage and integrate the visually impaired into the discipline of geography.

Methodology

Study subjects were matriculated students at institutions of higher education in North America. Additionally, the target schools were those with departments of geography. The two- and four-year colleges and universities that met these criteria were identified using the *Guide to Geography Programs in North America 2007-2008: AAG Handbook and Directory of Geographers* (AAG, 2007).

The questions that guided this research, as well as the construction of the survey instruments, were as follows:

1. Is there a difference in the perceived ability between visually impaired and non-visually impaired students to successfully complete a course or degree in geography and other visual disciplines?
2. Are visually impaired students taking courses in geography?
3. Are visually impaired students majoring in geography?

The direct solicitation of students was not possible due to both federal privacy laws (i.e., *Family Educational Rights and Privacy Act of 1974* – FERPA) and university privacy policies. Therefore, emails were sent to the directors of disability services at each campus asking them to disseminate the request to participate in the web-based survey to their visually impaired student populations. Emails were also sent to other administrators at the target schools requesting that they distribute the request to their non-sight impaired student populations. Participants were directed via hyperlink to one of two web survey instruments; one for sight impaired and one for non-sight impaired subjects. In addition to the survey having been designed in an accessible fashion for the visually impaired, participants were given the option to complete the survey by phone if they preferred. A more detailed profile of participants will be discussed later in this study.

Survey Construction

The study subjects were enrolled students at North American institutions of higher education that had departments of geography. The survey was designed to obtain: 1) profile information; and 2) perceived ability to successfully engage in geography, as well as other visual disciplines, and non-visual fields of study. The collection of data from both sighted and sight impaired

subjects permitted a statistical analysis to determine whether a significant difference between the two groups existed with respect to their perceived ability to successfully engage in and learn geography.

The survey consisted of two main sections. The first component presented profile interrogatives to identify participants' ethnicity, classification, marital status, number of geography courses taken in high school and college, sex, age, and income. Six additional questions were posed to the visually impaired. These questions were number of siblings in the household, presence of multiple disabilities, visual acuity, description of vision loss (i.e., congenital, adventitious, or gradual), enabling-technology usage and type of high school attended (i.e., mainstream or for the blind). A number of these variables were utilized by Li and Moore (1998; 2001), as well as Murr and Blanchard (2004), in their research on *labeling theory*.

The next section of the survey instrument posed six questions that addressed a subject's perceived ability to complete a course in six disciplines. Three of these fields of study were visual in nature, and the other three were considered to be relatively non-visual disciplines. Six questions were also presented with respect to a participant's perceived ability to earn a degree in these same academic disciplines. Based on a review of the literature, geography (Golledge, 1997), mathematics (Dick & Kubiak, 1997) and architecture (Holt-Jensen, 1999) were selected to represent visual disciplines. English, history, and philosophy were considered to be non-visual in nature. Participants were asked to rate their perceived difficulty in completing a course and degree in each of these six subject areas. They did so employing a Likert-type scale that ranged from 1 (extremely easy) to 10 (extremely difficult). Based on the collected data, comparisons were drawn between the two subpopulations that indicate significant differences exist between them and thus, support the need to examine theoretical approaches to better comprehend the obstacles to the effective transmission of geographic knowledge to the visually impaired.

Participant Demographic Data

Data were collected from both sight and non-sight impaired students. Visually impaired students who completed the survey instrument represented 25 institutions of higher education located in one Canadian province, 19 states, and the District of Columbia. Of these respondents, 14 (13.9%) were blind, 12 (11.9%) were severely legally blind, 47 (46.5%) were legally blind, and 28 (27.7%) possessed some other type of visual limitation (e.g., light sensitivity,

color blindness, etc.). Thirty-four participants (33.7%) were male, while the majority, sixty-seven (66.3%), were female.

In terms of the onset of vision loss, 26 subjects (25.7%) have undergone diminishment of visual acuity over time, while 59 (58.4%) experienced their visual loss at birth, and 16 (15.8%) adventitiously. With respect to ethnicity, 75 of the visually impaired respondents (74.3%) were White, 9 (8.9%) Black, 4 (4%) Hispanic, 0 (0%) American Indian, and 10 (9.9%) Asian/Pacific Islander. The remaining 3 subjects (3%) indicated having an ethnicity other than those specified via the survey instrument. Also, 97 students (96%) were matriculated at four-year institutions and 4 (4%) at two-year colleges. Regarding the country in which subjects were enrolled, 81 (80.2%) were attending United States institutions and 20 (19.8%) Canadian institutions.

The second group from which data was gathered were non-visually impaired students attending two- and four-year colleges and universities in North America. Data were collected from 90 non-visually impaired subjects enrolled at 12 institutions located in two Canadian provinces, 7 states, and the District of Columbia. As with the visually impaired participants, a majority of non-sight impaired respondents, 56 (62.2%), were female, while 34 (37.8%) were male. Seventy-one students (78.9%) were matriculated at U.S. institutions of higher learning and 19 (21.1%) at Canadian colleges and universities.

Regarding ethnicity, 57 respondents (63.3%) were White, 2 (2.2%) Black, 18 (20%) Hispanic and 8 (8.9%) Asian/Pacific Islander. No respondents indicated an ethnicity of American Indian and 5 subjects (5.6%) stated their ethnicity was some other than one of those specified on the survey questionnaire.

Results – General

This research study is designed to determine whether the visually impaired and non-visually impaired matriculated at postsecondary institutions have different experiences and perceptions of the discipline of geography. One manner in which to assess this study question is through the investigation of these students' exposure to geography in high school.

The visually impaired survey participants indicated taking on average less than one ($m = .91$) course in geography during high school (Table 1). Among the non-sight impaired, an average of 1.38 geography courses were taken. Both populations had a median score of 1. When using the Mann-Whitney test to examine these groups (population location parameters), which

yielded z = -3.085, the difference was considered to be statistically significant at a .002 level of probability. For the purpose of this test, as well as all others in this study, a confidence level of .05 was selected.

To further develop our understanding of this variance in exposure to geography, it should be noted that 40.6 percent (41) of students with a visual impairment had not taken a single course in high school geography as compared with only 18.9 percent (17) of non-sight impaired students. Therefore, the pre-postsecondary experience of students relative to formal geography education in the classroom is different—i.e., the visually impaired have had less exposure to geography than sighted pupils.

Table 1

Mann-Whitney Test on Number of High School Geography Courses.

Populations	N	M/Md	Mean of Rank	Sum of Ranks	Mann Whitney-U	Wilcoxon W	Z	Sig.
Visually Impaired	101	.91/1	85.1	8595.5	3444.5	8595.5	-3.085	.002
Non-Visually Impaired	90	1.38/1	108.25	9740.5				

Though the qualitative data collected in tandem with this research project is beyond the quantitative scope of this research report, it is illustrative to discuss some of those findings relative to varying experiences with classroom geographical pedagogy. When asked during phone interviews about the challenges encountered while taking geography courses in high school, non-sight impaired participants had few if any responses to this question. However, the visually impaired provided a number of comments in this area that include, but are not limited to: 1) too fine of a map print; 2) insufficient map contrast; 3) lack of tactile maps; and 4) too few and overly simplified geography exercises. These qualitative data suggest a relatively challenging learning environment among the sight impaired that was not apparently experienced in a similar or otherwise challenging fashion by their non-vision impaired peers. This disparity in the teaching-learning process among those engaged in high school geography, in conjunction with the disparity in course enrollment, suggests a sharp contrast in geography experience between the visually and non-visually impaired populations.

Through basic analysis of the survey data, it has been demonstrated that visually impaired and sighted participants have undergone a fundamentally different experience regarding engagement in and exposure to high school classroom geography. However, another important aspect to the underlying principles of this study is that of differing perceptions among these populations with respect to successful engagement in geographic study. To substantiate this assertion, an analysis was conducted on the expected difficulty in successfully completing a geography course and major. The visual disciplines of mathematics and architecture were also included in this investigation as were the non-visual fields of English, history, and philosophy.

Results – Visual Discipline Comparisons

Both the visually impaired and their sighted peers were asked via the survey instruments to rate their perceived abilities to complete a course and major in the previously identified visual and non-visual disciplines. They were requested to do so using a Likert-type scale ranging from 1 – 10 (1 being *extremely easy* and 10 being *extremely difficult*). The scores within each discipline were then compared between the vision and non-vision impaired populations employing the Mann-Whitney test to determine if a significant difference existed between their perceived abilities. For the purposes of analyzing data obtained from the Likert-type scales utilized in this study, it is assumed that each point on the scale is, in terms of measured perception, equidistant from the values adjacent to it.

For geography, the visually impaired population indicated a median expected ability to complete a course and major in geography at 6 and 6—both demonstrating greater perceived difficulty than ease. The non-sight impaired subjects reflected less perceived difficulty in both the completion of a course ($Md = 3$) and a major ($Md = 5$) within the discipline. There exists a difference among these two population medians of 3 and 1. The variation in distributions are statistically significant at .0001 for a course and .035 for a major in geography (Table 2). Thus, the data suggest that visually impaired students have a greater perceived difficulty in undertaking geographic study, which, in turn, may impact their perceived access to and likely engagement in such academic activities.

The variation between the two populations' perceived abilities regarding geography also translated to the visual disciplines of mathematics and architecture. This difference, however, is only at a statistically significant level with

one's expected ability to engage in a course within mathematics and architecture, but not in majoring within these disciplines. Visually impaired subjects reported a median ability of successfully undertaking a mathematics and architectural course at 5 and 6, respectively. Non-visually impaired students indicated a median ability of 3 and 5 (a difference of 2 and 1). Though the variation between medians with these disciplines' course variables is not as large as that found with geography courses (median difference of 3), they are statistically significant at .022 for mathematics and .035 for architecture (Table 2).

When assessing the differences in perceptions relative to majoring in mathematics and architecture, the visually impaired still view such an endeavor (in terms of median scores) as being equally or more challenging than do the non-sight impaired. Those with no or limited vision perceived a difficulty in completing a mathematics major at $Md = 6$ compared with non-sight impaired subjects at $Md = 6$ (a difference of 0). When considering a major in architecture, the median response was 8 among the visually impaired and 6 among sighted students (a difference of 2). However, the variations in population location parameters are not statistically significant (Table 2), and, thus, neither population perceives any statistically greater difficulty than the other in majoring within mathematics or architecture.

Table 2

Mann-Whitney Test on Perceived Ability to Complete a Visual Course and Major.

Discipline	*N	*Md	*Mean of Rank	*Sum of Ranks	Mann Whitney-U	Wilcoxon W	Z	Sig.
Geography Course	101/ 90	6/3	115.5/ 74.12	11665.5/ 6670.5	2575	6670.5	-5.204	.0001
Geography Major	101/ 90	6 / 5	103.91/ 87.12	10495/ 7841	3746	7841	-2.109	.035
Mathematics Course	101/ 90	5 / 3	104.58/ 86.37	10562.5/ 7773.5	3678.5	7773.5	-2.296	.022
Mathematics Major	101/ 90	6 / 6	96.15/ 95.83	9711.5/ 8624.5	4529.5	8624.5	-.041	.967
Architecture Course	101/ 90	6 /5	103.9/ 87.13	10494/ 7842	3747	7842	-2.109	.035
Architecture Major	101/ 90	8 / 6	101.02/ 90.36	10203.5/ 8132.5	4037.5	8132.5	-1.344	.179

**Visually impaired subject data are provided first, followed by non-visually impaired subject data.*

The analysis suggests, with respect to undertaking a course, as well as majoring in a field of study, that geography alone among the visual subjects produces a statistically significant variation in perceived ability between the visually impaired and the control population. Such a perception could result in a lack of participation among such individuals in the discipline of geography and, therefore, hinder the diversity of thought and potential problem resolution relative to spatial, geographical issues. However, it is important not to examine this potential barrier to knowledge transmission and learning solely in the context of visual disciplines, but also within the framework of non-visual disciplines.

Results – Non-Visual Discipline Comparisons

To further make the case that geography is perhaps unique among disciplines in terms of the perceptions that visually impaired students have of their ability to be successful in this field of study, it is crucial to also assess such perceptions in relationship to non-visual disciplines. For this examination, English, history, and philosophy were selected to represent disciplines of a relatively non-visual nature. Thus, as with the visual disciplines, both visually impaired and non-visually impaired students were asked to rate their anticipated ability to successfully undertake a course and major in each of the non-visual disciplines using the 10-point perception scale.

Regarding perceived ability to engage in a course in each of these fields of study, those with sight impairments rated their median abilities in English, history, and philosophy as 2, 3, and 3, and non-sight impaired subjects as 2, 3, and 3 respectively. Visually impaired students had equal median levels of difficulty in all three disciplines. The distributions of scores are not statistically significant (Table 3). In other words, unlike with visual courses no real difference exists in the perceived level of difficulty, or ease, in completing non-visual courses.

When assessing the data on the perceived ability to complete a major in a non-visual discipline, it is interesting to note that while there is no statistically significant difference in perceived ability between the study populations relative to English ($p = .124$), there is a statistically significant difference with respect to both history and philosophy (Table 3). However, visually impaired respondents demonstrated a median perceived ability to pursue a history major at 3 and philosophy at only 4. These figures are in contrast to the higher median scores (indicating greater perceived difficulty) of non-sight impaired individuals whose median scores were 5 for history and 6.5 for philosophy.

These figures result in a difference of 2 and 2.5, respectively. The difference in these population location parameters are statistically significant at .001 for history and .0001 for philosophy. These variations suggest that the visually impaired perceive greater ease at earning a history and philosophy degree than their sighted counterparts in this research study.

Overall, the analysis of non-visual discipline data relative to perceptions confirms that the visual disciplines, and in particular geography, inherently present potential obstacles to access among certain special needs populations—i.e., those with no or limited visual acuity. This challenge to the geography discipline can perhaps be additionally illustrated by data collected on survey participants' choice of major. While 2.2 percent of non-sight impaired students are majoring in geography, no visually impaired students had selected this field for their major.

Table 3

Mann-Whitney Test on Perceived Ability to Complete a Non-Visual Course and Major.

Discipline	*N	*Md	*Mean of Rank	*Sum of Ranks	Mann Whitney-U	Wilcoxon W	Z	Sig.
English Course	101/ 90	2/2	97.37/ 94.47	9834/ 8502	4407	8502	-.373	.709
English Major	101/ 90	3/4	90.24/ 102.47	9114/ 9222	3963	9114	-1.539	.124
History Course	101/ 90	3/3	97.56/ 94.25	9853.5/ 8482.5	4387.5	8482.5	-.421	.674
History Major	101/ 90	3/5	83.72/ 109.78	8455.5/ 9880.5	3304.5	8455.5	-3.275	.001
Philosophy Course	101/ 90	3/3	95.26/ 96.83	9621/ 8715	4470	9621	-.199	.842
Philosophy Major	101/ 90	4/6.5	80.62/ 113.26	8142.5/ 10193.5	2991.5	8142.5	-4.099	.0001

**Visually impaired subject data are provided first, followed by non-visually impaired subject data.*

Conclusion

While there is a statistically significant difference in perceived success between the two subpopulations regarding their engagement in the visual disciplines of mathematics and architecture, and not at all among the non-visual subjects, geography is the sole field in which such a strong variation in

perception also applies to the major variable. It is this unique characteristic of the discipline (i.e., its perceived inaccessibility in contrast to non-visual and other visual fields of study) that serves to hinder, if not stop altogether, the conveyance and reception of geographic information to the visually impaired. This challenge may be the result of both the discipline's subject-matter and the manner in which its content is taught. This finding answers the study's first research question (*Is there a difference in the perceived ability between visually impaired and non-visually impaired students to successfully complete a course or degree in geography and other visual disciplines?*).

This challenge is underscored by the lower involvement of the visually impaired in high school geography courses. As a result, these students, once in college, actively avoid geography and the hardships associated with learning information that is perceived to be relatively inaccessible. This generalized belief explains the higher percentage of visually impaired students—over 40 percent—who have not enrolled nor plan to enroll in even a single geography course as compared with only about one-fifth of the non-visually impaired who think likewise. This information, along with the data that no visually impaired subjects were majoring in geography, answers research questions two (*Are visually impaired students taking courses in geography?*) and three (*Are visually impaired students majoring in geography?*).

Identifying the existence of a difference in perception between the two study groups (sight and non-sight impaired) was a fairly straightforward proposition. However, exploring beyond the pure pedagogical limitations of current geography education is not enough. In order to better comprehend the impediments to geography learning among the visually impaired, theoretical frameworks must be utilized.

One possible theoretical path of investigation is the role stigmatization may play in erecting social and, ultimately, internal barriers among the visually impaired to their positive perceptions and thus, likely engagement in geographic studies. There are a variety of sociological and psychological theories that could be utilized to guide such research. *Labeling theory* (Tannenbaum, 1938; Becker, 1963; Smith, 1980; Li & Moore, 2001; Orcutt, 2002) and *stereotype threat theory* (Steele & Aronson, 1995; Schmader & Johns, 2003; Abrams et al., 2006; Keller 2007) are two such examples. These theories offer frameworks by which to assess the effect sociological and psychological mechanisms produce in erecting potential obstacles to the learning of geography among the visually impaired.

Once such research is undertaken, as well as qualitative studies to provide a more robust picture of the challenges, informed action can then be taken to remove these barriers to the successful conveyance of geographic

information to the visually impaired. The enhanced engagement of the visually impaired in geographical thought and problem solving will result in more diverse, more dynamic solutions to the geo-spatial issues facing our world.

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Christopher D. Murr recently earned his doctorate in geography from Texas State University. He currently serves as the director for Financial Aid and Scholarships at Texas State, and his research focus is in environmental geography and geography education.