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Is Sensory Profile a Predictor of Academic Achievement and
Academic Discipline Choices?

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Abstract

The following literature review is a collaboration of both theoretical and empirical studies. The purpose of the review is to examine the role of sensory sensitivity on an individual's threshold of tolerance. This will include previous research using the Dunn Model of Sensory Processing. Sensory sensitivity may also produce sensory preferences. These preferences make a student choose specific sensory modalities in their learning style. In addition, the review will look at the role of these sensory modalities in learning styles in students and how these sensory modalities relate to academic achievement and academic discipline choices. The results of the studies indicate a need for future research with use of the Adult Sensory Profile and a need to investigate sensory modalities in university students.

Is Sensory Profile a Predictor of Academic Achievement and Academic Discipline Choices?

People vary in what they are sensitive to in their environment. Sensory sensitivities may affect an individual's threshold of tolerance. This threshold of tolerance combined with behavioural responses creates a sensory profile of an individual. (Dunn, 1997). In a review, O'Neil and Jones (1997) suggested that the research in sensory sensitivities had limitations because many of the studies focused their research on children and specific clinical diagnosis. Differences in people in their sensitivities may also produce sensory preferences. A sensory preference is an individual's tendency to rely on information from a particular sense. For example, a person may prefer engaging in an activity that involves more auditory stimuli than visual stimuli. This may be a person that prefers listening to music rather than reading a book. Having preferences for certain sensory experiences can support or be disruptive to an individual's learning and performance (Dunn, 1997). Sensory preferences are a contributing factor in the learning processes of individuals and hence, their learning styles. A learning style is an individual's approach to his/her environment. In a review, Hoffer (1986) indicated that several of the learning factors attributed to adults are based primarily on research on children and teenagers. Several previous studies (Shaughnessy, 1998; Raiszadeh, 1999; Snyder, 2000; Cheng, 2001; Jones, 2001) have examined sensory modalities in learning styles in students and some have considered how sensory modalities relate to academic achievement and academic discipline choices. The purpose of the present review is to evaluate the role of sensory sensitivity on an individual's threshold of tolerance. This will include previous research using the Dunn Model of Sensory Processing. Moreover, the

review will evaluate the relationship of sensory modalities in learning styles of students with academic achievement and academic discipline choices.

Sensitivity may affect preferences by making some stimuli pleasant and sought out or by making some stimuli aversive and avoided. An individual who is visually sensitive may enjoy examining details in pictures and books but may also avoid bright lights (Ongan & Wood, 2000). An individual who is sensitive to auditory stimuli may prefer certain sounds such as theme songs and at the same time dislike and avoid the sounds of particular musical instruments and noises of household appliances. An individual who is sensitive to tactile stimuli may prefer stroking hair, earrings, navels, bare skin and soft surfaces but may avoid or be distressed by getting an inoculation or wearing wet clothing.

An individual sensitive to smell may prefer to use a specific perfume scent but may find some common odors noxious (Ongan & Wood, 2000). An individual who is sensitive orally may prefer eating junk food and may dislike the feeling they get in their mouth when they wake up in the morning. An individual who is bodily sensitive may prefer walking to running and may avoid activities that involve whirling and spinning.

How an individual responds to stimuli in their environment is affected by their ability to modulate sensory information. Modulation is the ability to monitor and regulate information in the interest of generating an appropriate response (Dunn, 1997). Dunn's (1997) Model of Sensory Processing presents a sensory profile of an individual based on their threshold of tolerance and behavioural response. An individual with a high neurological threshold is someone who has a lack of response or needs more intense sensory stimuli. An individual with a high neurological threshold is someone who notices

or is annoyed with sensory stimuli. Those two thresholds interact with two dimensions of sensory behaviour that are active and passive. A passive person is someone who responds in accordance with his or her neurological threshold. An active is someone who has tendency to counteract his or her neurological threshold. Those two dimensions combine to create four conditions or sensory types.

Low registration is a passive response to a high neurological threshold (Dunn, 1997). This may involve behaviours such as missing a sensory stimulus or a slow response. For example, someone who doesn't smell things others smell or taste the spice in food. Sensory sensitivity is a passive response to a low neurological threshold. This may involve behaviours such as distractibility or discomfort with sensory stimuli. For example, someone who becomes frustrated finding something in a drawer or is bothered by that feeling in their mouth when they wake up in the morning. Sensory Seeking is an active behavioural response to a high neurological threshold. This may involve pursuing stimuli to produce enjoyment or creativity. For example, someone that enjoys doing things on spur of the moment, eating spicy foods or finds activities to perform in front of others. Sensation Avoiding is an active behavioral response to a low neurological threshold. This may be behaviours that are deliberate acts to reduce or prevent exposure to sensory stimuli such as limiting distractions while working or avoiding larger groups of people. An individual's sensory profile is based on the strength of their scores on the four sensory types and the scores can vary in degree.

Current methods available in measuring sensory sensitivities included checklists, rating scales and questionnaires. O'Neill and Jones (1997) suggested that the research in the area of sensory sensitivities had its limitations because many of the studies did not

include control groups and parental questionnaires can be inaccurate. The researchers suggest that the prevalence of sensory sensitivities needs to be better established in adults. It would help indicate if sensory sensitivities are straight maturational effects or if developmental and learning influences are relevant (O'Neill & Jones, 1997).

Based on the Dunn Model of Sensory Processing, the Sensory Profile was created (Dunn, 1999). This is a 125-item parental questionnaire that was the first sensory processing assessment for which normative data had been reported. Ongan and Wood (2000) suggested that a questionnaire that could provide more detailed information about a child's sensory sensitivities would be a useful tool that could establish the range and extent of sensory sensitivities.

Watling, Deitz and White (2000) compared the Sensory Profile scores of 40 children without disabilities to 40 children with autism. The researchers focused on age 3 to 7 years. The parents of the children were asked to fill out the Sensory Profile that was a five-point Likert Scale to record the frequency of their child's behaviour. Watling, Deitz and White were looking for significant differences between scores of children without disabilities and the children with autism. The results showed that many children with autism (N=16) had scores lower than children without disabilities on Poor Registration. The results also showed that at least 85 % of the children with autism scored lower than the children without disabilities on at least one factor on the Sensory Profile.

As a group, the children with autism also had scores that spread further across the possible score ranges than the children without autism which suggested the autistic group many not be homogenous. The highest scores were seen on Sensory Seeking, which was

a mean of 52.6 for the children with autism and a mean of 68.7 for the children without autism. Walting, Deitz and White (2000) concluded that the Sensory Profile was a useful tool in measuring sensory deficits in children. The researchers suggested that future research should consider the use of control groups or other diagnostic groups.

There was a need to develop a measure that could not only consider children but adults as well. The Adult Sensory Profile was developed (Brown, Tollefson, Dunn, Cromwell & Fillion, 2001) based on the previous Sensory Profile (Dunn, 1999) and the Dunn Model of Sensory Processing (Dunn, 1997). Previously the interest in sensory sensitivities and preferences had been directed primarily towards children. The Adult Sensory Profile was developed to measure sensory preferences in adolescents and adults. The Adult Sensory Profile is a self-report questionnaire that contains four sensory types: sensation avoiding, sensation seeking, sensory sensitivity or low registration. The items on the Adult Sensory Profile described behaviours in terms of everyday experiences such as the avoidance of large crowds or the enjoyment of doing things on spur of the moment. Brown et al. (2001) conducted their preliminary research in the area of clinical diagnosis.

Brown, Tollefson, Dunn, Cromwell and Fillion (2002) wanted to test whether the Dunn Model of Sensory Processing and the Adult Sensory Profile were useful for understanding sensory processing in schizophrenia. Brown et al. used the Adult Sensory Profile to measure 86 individuals with no mental illness, schizophrenia and bi-polar disorder. The results indicated that there were significant differences between the groups on the sensation avoiding subscale. The schizophrenia group scored a mean of 40.9, the bi-polar group scored a mean of 43.3 and the mentally healthy group scored a mean of 31.1. There were no significant differences found between the groups on the low

registration and sensation seeking scales. The researchers found that with the schizophrenic group when the input is intense enough to be registered it is perceived as aversive and avoided. However, the mentally healthy response was to register input, perceive it as advantageous and then seek additional information. Brown et al. concluded that their study provided preliminary evidence for applying a theoretical model towards understanding sensory preferences in schizophrenia. Brown et al. indicated that there was a need to distinguish the meaning and usefulness of the Dunn Model of Sensory Processing and the Adult Sensory Profile. They had distinguished its usefulness in areas of clinical diagnosis but there needed to be an investigation into a normal population. Investigating in a natural setting would help researchers relate those everyday sensory experiences to learning processes.

A person's learning style is the way that he or she attends to, selects, internalizes and remembers new and difficult academic information and skills (Shaughnessy, 1998). Research on learning styles in students has focused on visual, tactile, auditory and kinesthetic learning. Visual learners are individuals who learn best by watching and observing their environment. For example, visual learners may focus on pictures or words on a screen and are able to store that information into memory. Auditory learners are individuals who rely on learning information from what they hear in their environment. Students who prefer an auditory style can understand information by listening to what a teacher says in class and placing the auditory information into memory. Tactile learners are individuals who rely on touch as their approach to learning information. Kinesthetic learners are individuals who rely on their own bodily sensations.

Tactile and kinesthetic learners are related because they must apply their knowledge to facilitate their learning. For example in a university setting, art students use both tactile and kinesthetic approach through the use of painting or the manipulation of materials such as clay.

Instruments, inventories and questionnaires have measured the various learning styles in students. Previous research has suggested that there is a relationship that exists between learning styles and academic achievement as well as academic discipline choices. In a review, Shaughnessy (1998) contrasted the role of learning styles in high and low achievers in school. High achievers tend to prefer kinesthetic and tactile learning but they are able to master visual and auditory domains as well. High achievers tend to have many perceptual strengths. Low achievers who prefer tactile and kinesthetic learning can only master through those modalities that is they lack in the areas of auditory and visual learning. Low achievers tend to have only a single perceptual strength. Low achievers also tend to have poor auditory memory. For example, low achievers want to do well in school however their inability to remember facts through lectures, reading and discussions effect their performance in school.

Raiszedeh (1999) wanted to investigate if learning styles related to personality types and academic achievement. The Learning Style Inventory was administered to 202, college mathematics students. He initiated the study with the goal of providing the information to professors in order to enhance their students learning. He found that students with tactile preferences achieved lower mathematics scores then their counterparts who had visual and auditory preferences. He concluded that sensory modalities needed to be further investigated to understand their possible impact on

students learning. This could involve more focus on subject areas, grade levels or academic discipline choices. Synder (2000) indicated that the research on sensory modalities in learning had focused on elementary and college settings.

Gadt-Johnson and Price (2000) used the Learning Style Inventory to compare students in grades five through twelve. The learning style differences of students that preferred a tactile learning environment were compared those students that did not prefer a tactile learning environment. The subjects were divided into two groups based on their scores on the tactile domain. There were 4938 students that scored 40 or below that were compared to 3862 students that scored 60 and above. The researchers reported that students who preferred a tactile learning environment also preferred to learn more through kinesthetic and auditory modalities. In addition, as grade level increased, tactile learning decreased from 53.38% in grade five to 47.55% in grade 12. The researchers concluded that there was a need to familiar with students' learning styles in order to facilitate the appropriate selection of learning materials.

Using the Learning Style Inventory, Jones (2001) examined the relation of learning styles with academic performance and subject area sensitivity. The purpose of the study was to see if community college students' learning styles varied by subject area, gender and academic performance. There were 105 community college students in the study. Both male and female subjects participated. Learning styles were compared to subject areas of English, Math, Science and Social Science. The results showed that there were significant relations between learning style and subject area. There were also significant relations between learning styles and academic performance. The researcher concluded that students adapt their learning strategies depending on the discipline that

they are in. The researchers indicated that there was a need to investigate the relation of sensory modalities with academic discipline choices.

Cheng (2001) used the Reid's Perceptual Learning Style Inventory to compare the preferred learning styles of 688 students in seven different academic programs. The students' differences in learning were compared to the opinions of 68 teachers. The results showed that across all of the academic programs the students reported auditory learning as their most preferred learning style. However, the teachers in the programs preferred the students to demonstrate their learning through kinesthetic learning. The results indicated there may be a trend across academic programs with regards to sensory modalities.

Brown, Cromwell, Filion, Dunn and Tollefson (2002) concluded the Adult Sensory Profile needs be used more in future research in order to distinguish its meaning and usefulness. Thus, there is need to apply the Dunn theoretical model to a more normal population. The results of the studies on learning styles in students had shown that sensory modalities are an important factor to a student's learning style. Those sensory modalities also may predict how a student achieves in school and chooses their academic discipline. The majority of research on sensory modalities in students has focused on elementary to college settings. Thus, indicating a need to investigate sensory modalities in older populations such as university students.

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Previous research has established that sensory sensitivities may produce specific sensory preferences. These sensory modalities influence an individual's learning style and impact their academic achievement. Sensory sensitivity may also affect an individual's threshold of tolerance. The purpose of this study was to examine sensory profiles in a normal population and their relationship to academic achievement and academic discipline choices. This study used the Adult Sensory Profile that had not been previously used in educational research. The Adult Sensory Profile is a measure of a person's threshold of tolerance against their behavioural response to sensory stimuli. Although no significant differences were found in this study, the results indicated that there might be a sensory behaviour associated with university students.

Introduction

People vary in what they are sensitive to in their environment. Sensory sensitivities may affect an individual's threshold of tolerance. This threshold of tolerance combined with behavioural responses creates a sensory profile of an individual. (Dunn, 1997). In a review, O'Neil and Jones (1997) suggested that the research in sensory sensitivities had limitations because many of the studies focused their research on children and specific clinical diagnosis. Differences in people in their sensitivities may also produce sensory preferences. A sensory preference is an individual's tendency to rely on information from a particular sense. For example, a person may prefer engaging in an activity that involves more auditory stimuli than visual stimuli. This may be a person that prefers listening to music rather than reading a book. Having preferences for certain sensory experiences can support or be disruptive to an individual's learning and performance (Dunn, 1997). Sensory preferences are a contributing factor in the learning processes of individuals and hence, their learning styles. A learning style is an individual's approach to his/her environment. In a review, Hoffer (1986) indicated that several of the learning factors attributed to adults are based primarily on research on children and teenagers. Several previous studies (Shaughnessy, 1998; Raiszadeh, 1999; Snyder, 2000; Cheng, 2001; Jones, 2001) have examined sensory modalities in learning styles in students and some have considered how sensory modalities relate to academic achievement and academic discipline choices.

How an individual responds to stimuli in their environment is affected by their ability to modulate sensory information. Modulation is the ability to monitor and regulate information in the interest of generating an appropriate response (Dunn, 1997).

Dunn's (1997) Model of Sensory Processing presents a sensory profile of an individual based on their threshold and behavioural response. O'Neill and Jones (1997) suggested that the research in the area of sensory sensitivities had its limitations because many of the studies did not include control groups and parental questionnaires can be inaccurate. The researchers suggest that the prevalence of sensory sensitivities needs to be better established in adults. This would help indicate if sensory sensitivities are straight maturational effects or if developmental and learning influences are relevant.

Based on the Dunn Model of Sensory Processing, the Sensory Profile was created (Dunn, 1999). This is a 125-item parental questionnaire that was the first sensory processing assessment for which normative data had been reported. Ongan and Wood (2000) suggested that a questionnaire that could provide more detailed information about a child's sensory sensitivities would be a useful tool that could establish the range and extent of sensory sensitivities. Watling, Deitz and White (2000) compared the Sensory Profile scores of 40 children without disabilities to 40 children with autism. Watling, Deitz and White (2000) concluded that the Sensory Profile was a useful tool in measuring sensory deficits in children. The researchers suggested that future research should consider the use of control groups or other diagnostic groups.

There was a need to develop a measure that could not only consider children but adults as well. The Adult Sensory Profile was developed (Brown, Tollefson, Dunn, Cromwell & Fillion, 2001) based on the previous Sensory Profile (Dunn, 1999) and the Dunn Model of Sensory Processing (Dunn, 1997). Previously the interest in sensory sensitivities and preferences had been directed primarily towards children. The Adult Sensory Profile was developed to measure sensory preferences in adolescents and adults.

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mathematics scores than their counterparts who had visual and auditory preferences. He concluded that sensory modalities needed to be further investigated to understand their possible impact on students learning styles and academic achievement. This could involve more focus on subject areas, grade levels or academic discipline choices. Synder (2000) indicated that the research on sensory modalities in learning had focused on elementary and college settings.

Using the Learning Style Inventory, Jones (2001) examined the relation of learning styles with academic performance and subject area sensitivity. The purpose of the study was to see if community college students' learning styles varied by subject area, gender and academic performance. There were 105 community college students in the study. Both male and female subjects participated. Learning styles were compared to subject areas of English, Math, Science and Social Science. The results showed that there were significant differences between learning style and subject area. There were also significant differences between learning styles and academic performance. The researcher concluded that students adapt their learning strategies depending on the discipline that they are in. The researchers indicated that there was a need to investigate the relation of sensory modalities with academic discipline choices.

Cheng (2001) used the Reid's Perceptual Learning Style Inventory to compare the preferred learning styles of 688 students in seven different academic programs. The students' differences in learning were compared to the opinions of 68 teachers. The results showed that across all of the academic programs the students reported auditory learning as their most preferred learning style. However, the teachers in the programs preferred the students to demonstrate their learning through kinesthetic learning. The

results indicated there may be a trend across academic programs with regards to sensory modalities.

Sensory modalities' affecting an individual's performance is not a new idea. For example, autistic individuals are an extreme example of sensory sensitivity. In a review, Dawson and Watling (2000) reported that between 20-100 percent of autistic individuals display sensory sensitivities of some kind. Autistic individuals also have strong sensory preferences. For example, some autistic individuals prefer extremely loud levels of music or television, activities that involve spinning or hand flapping and dislike being touched unless they initiate it (Ongan & Wood, 2000). Autistic individuals also have difficulty learning and achieving in their educational environments. Autistic individuals are an extreme example of the relationship between sensory preferences and academic achievement. Most of the preliminary research using the Sensory Profile (1999) and the Adult Sensory Profile (2001) has focused on clinical diagnosis, particularly, autistic individuals. In addition, the research on sensory modalities in students has focused on elementary to college settings. There is a need to investigate sensory profiles in a normal population. This could involve using a population such as university students.

If sensory preferences influence learning styles and if learning styles influence academic achievement and academic discipline choices; then a sensory profile may predict academic achievement. A sensory profile may also predict academic discipline choices. The Adult Sensory Profile is a questionnaire that measures sensory preferences and gives a sensory profile of an individual but has not been used in educational research. The purpose of this study is to determine whether sensory profile can predict academic achievement and academic discipline choices.

Method

Participants

The participants were 45 students from Algoma University College. The participants were recruited from three academic disciplines. There were 15 students chosen from Art, Psychology and Computers. The age of the participants ranged from 18 to 67. Both male and female subjects were used. The participants were asked of their potential and estimated academic averages from the previous semester.

Materials

The Adult Sensory Profile questionnaire was given to all the participants. To complete the Adult Sensory Profile, participants used a 5-point Likert scale ranging from always to never. The Adult Sensory Profile is a self-report questionnaire that contains 60 items. These items are related to the four quadrants: sensation seeking, sensation avoiding, low registration and sensory sensitivity. Each item on the questionnaire describes everyday sensory experiences such as being afraid of heights or avoiding large groups of people. In addition, the items cover sensory categories of visual, auditory, tactile, taste, smell and movement. Each quadrant is treated separately, which gives four separate mean averages of an individual. An individual can have scores on all of the quadrants and these scores can vary. The mean scores on the four quadrants are measured on a scale from much less than most people to much more than most people, the lowest score being 15 and the highest score being 75. These four means gave a sensory profile of the students.

The participants were also given a separate sheet of paper that asked them two questions. The first question was asking of their estimated academic average from the

previous semester. The second question asked them of where they thought their potential average would be. They were given a range from 50 to 100. The participants were asked of their potential averages because they would be more likely to be honest about their estimated academic averages. Also, this would make the participants' estimated academic averages more accurate.

Procedure

The Adult Sensory Profile questionnaires and academic average sheets were all numbered and colour coded before the study began. The colours of yellow, red and blue were used to separate the groups into the three academic disciplines. The experimenter brief explained the study to all the participants. All of the participants gave their informed consent to be a part of the study. The experimenter assured all the participants that they could withdrawal from the study at any time. The participants were asked of their estimated and potential academic averages. The experimenter assured them of the confidentiality of these academic averages. While the participants completed the questionnaires the experimenter was present at all times to answer any questions they had. The academic averages were organized into four groups from the top 25% to the lowest 25%. These four groups were group 1 (100-84), group 2 (83-80), group 3 (80-75) and group 4 (75-57). Both the major choices and the four academic groups were measured separately against the sensory profiles of the students.

Design and Data Analysis

A group comparison design was used to describe sensory profiles of students in the four academic groups and three academic disciplines. There were three measures used in the study, which were academic achievement, academic discipline choice and sensory profile. The questionnaires were scored according to the Adult Sensory Profile User Manual (Brown, Cromwell, Filion, Dunn & Tollefson, 2001). Each participant response on each item was converted to a numerical value that corresponded to the frequency of the sensory behaviour (i.e., 1=almost never, 2=seldom, 3=occasionally, 4=frequently and 5=almost always). This conversion gave the frequent behaviours the highest scores. The raw scores on each item were organized into the four quadrants of sensation seeking, low registration, sensory sensitivity and sensation avoiding. The mean scores on the four quadrants were transferred to the quadrant summary chart. This summary chart placed a student's score from much less than most people to much more than most people, the lowest score being 15 and the highest score being 75.

Scores on the four quadrants of the Adult Sensory Profile were compared across the four academic groups using a one-way ANOVA. The scores on the four quadrants were also compared across the three academic disciplines using one-way ANOVA. The one-way ANOVA was chosen because it compares groups on a continuous variable. This was to test the hypothesis that an individual's sensory profile could predict how they achieve and how they choose their academic discipline.

Results

Based on the one-way ANOVA, there were no significant differences found between academic achievement and sensory profile. There were four one-way ANOVAs used to compare academic groups to the four quadrant scores. There were no significant differences between sensation seeking and academic group ($F(4, 44) = 1.5, p > .05$). There were no significant differences found between sensation avoiding and academic group ($F(4, 44) = 1.2, p > .05$). There were no significant differences found between sensory sensitivity and academic group ($F(4, 44) = .238, p > .05$). There were no significant differences found between low registration and academic group ($F(4, 44) = .121, p > .05$).

There were no significant differences found between academic discipline choice and sensory profile. There were four one-way ANOVAs used to compare the three academic disciplines to the four quadrant scores. There were no significant differences found between sensation seeking and academic discipline ($F(3, 44) = 1.6, p > .05$). There were no significant differences found between sensation avoiding and academic discipline ($F(3, 44) = .368, p > .05$). There were no significant differences found between sensory sensitivity and academic discipline ($F(3, 44) = .190, p > .05$). There were no significant differences found between low registration and academic discipline ($F(3, 44) = .57, p > .05$).

The most salient result was that across both the academic groups and academic disciplines, the highest levels were seen on sensation seeking. In addition the lowest levels were seen on low registration and moderate levels on sensation avoiding and sensory sensitivity. According the Adult Sensory Profile Manual (2001) high scores on

sensation seeking indicate an individual wants to find ways to explore their environment, be spontaneous and engage actively with the sensory world. A person with low scores on low registration indicates an individual does not miss sensory stimuli but rather that he or she is not likely to overlook stimuli in the environment. When the researcher looked at the participants' scores individually it was found that over 50% of the participants scored highest on Sensation Seeking and lowest on Low Registration. Thus suggesting that there may be a pattern emerging between those two sensory types and students.

Discussion

Although there were no significant differences found in this study there still may be a type of sensory behaviour associated with university students. This was evident by how many students across both academic groups and academic disciplines scored the highest on Sensation Seeking and the lowest on Low Registration. Over 50% of the students in this study showed this pattern. This is the first study that used the Adult Sensory Profile with university students. In order to understand these patterns of sensory behaviour in students there needs to be additional research in this area. Future research should consider investigating students and their sensory types and comparing them to other groups.