Chapter 12: Intelligence and Creativity

Overview

Much of the study of **intelligence** has focused on the psychometric approach. The goal of psychometric theorists is to identify precisely what the traits of intelligence are and to measure these traits so that intellectual differences among individuals can be described. In 1904, Binet and Simon were commissioned by the French government to construct a test that would identify "dull" children who might benefit from special education. Items from the original battery of tasks that successfully discriminated normal children from those described by teachers as dull were kept in later versions of the test. Binet and Simon decided which items to keep on the test based on which were good predictors of what the teachers thought about the children. Encourage students to think about potential problems with this method (teachers thought that Albert Einstein was "slow" when he was a child).

Commonly-used intelligence tests today are standardized, meaning that scores are compared to a pre-tested group. Intelligence test scores, like many other psychological measures, conform to a normal distribution: a few people score very low, a few score very high, and most are somewhere in the middle. Tests are re-standardized every few years to account for shifts in scores (i.e., the **Flynn effect**).

In discussing Sternberg's **triarchic theory of intelligence**, it is useful to point out that the three proposed components of intelligent behaviour differ in terms of how much they are valued in the classroom. **Analytical intelligence** tends to be favoured in traditional classrooms—the students who are high on this component tend to be the "good" students. **Practical intelligence** is not usually assessed by traditional intelligence tests and it is not particularly highly valued when it comes to classroom behaviour or marks in school. **Creative intelligence** is also not necessarily highly valued in the classroom. If a teacher gives an assignment, a child who scores very highly on the creative component is likely to give an answer that does not fit with the answer key and it depends on the teacher whether this is seen as a good thing or a bad thing.

The role of nature and nurture can be addressed for IQ scores. There is no doubt that environmental influences play a role in intelligence and, therefore, severely deprived environments take a toll on children intellectually. Parents who provide lots of opportunities for learning and who provide stimulating environments tend to have intelligent children. Keep in mind, though, that parents who provide that kind of environment also tend to be intelligent themselves and, because of genetic influences, smart parents tend to have smart kids.

Creativity, like intelligence, is incredibly difficult to define and when a concept is hard to define, it is hard to measure. It could be argued that assessments of creative thinking should involve taking into consideration the novelty or uniqueness as well as the usefulness of ideas. It is helpful to give students example problems and encourage creative solutions. The example below is referred to as "McGruffin's problem." See how creative your students can be. The task is to give an explanation for how this situation is possible:

> Paul McGruffin was born in 1986 in St Louis, Missouri. His father was Irish; his mother Native American. Fifty-two years later, he dies while playing chess with Albert Einstein in Nebraska. However, he dies in 1999.

Learning Objectives

In this chapter students will:

- Examine the various ways in which cognitive psychologists have conceptualized intelligence and how these conceptualizations have changed over time.
- Describe the Flynn effect and look at possible explanations for it.
- Review and evaluate Robert Sternberg's theory of successful intelligence.
- Critically consider Howard Gardner's theory of multiple intelligences.
- Identify the factors related to the development of expertise.
- Explain the processes involved in creativity.

Key Concepts with Illustrative Examples

analytical, creative, and practical intelligence (see page 386)

Sternberg's triarchic theory of intelligence incorporates these three types of intelligence. The analytical component refers to an ability to size up the requirements of a problem and to formulate strategies to solve the problems. Individuals who are high in this component can process information faster and more efficiently than others. The creative component refers to a person's ability to generate good ideas or fresh insights. The practical component reflects how successfully someone can adapt to their environment or effectively shape their environment to suit them better ("street smarts").

chance permutations (see page 397)

Back in the late 1980's a popular action-adventure television show featured McGyver (also the name of the show), who often found himself facing danger in very complex situations. Somehow McGyver always managed to escape by using nothing more than a Swiss army knife and everyday objects. He combined his knowledge of the physical sciences with obvious intelligence that spanned many different areas to find unique and creative solutions to complex problems. MyGyver's problem solving usually involved chance permutations which are different combinations of mental elements produced according to no set rule.

crystallized and fluid intelligence (see page 379)

Crystallized intelligence can be thought of as a knowledge base, a collection of things you have learned. It may be greatly affected by education and culture and it may increase throughout adulthood. Fluid intelligence is better thought of as an ability—an ability, for example, to see meaning in things or to react to a situation intelligently. Knowing the chemical formula for helium would be part of crystallized intelligence; being able to use helium to invent a floating contraption to escape captivity would tap into fluid intelligence.

dedicated vs improvisational intelligence (see page 382)

There are some problems in life that we encounter frequently such as finding the quickest route to take to school or work every day. According to Cosmides and Tooby (2002), these types of problems, such as way-finding or even finding a mate, would draw on what they termed as "dedicated intelligence." Dedicated intelligence is associated with domain-specific modules and would have evolved to solve recurring problems. Improvisational intelligence, on the other hand, is a more flexible intelligence that would have evolved to deal with novel, unexpected problems.

Flynn effect (see page 382)

The Flynn effect refers to the finding that an average person's IQ score tends to rise over historical time. People today do better on IQ tests than they did 50, 30, or even 10 years ago. This trend can be explained by a variety of factors: improved nutrition and health, better education, greater environmental complexity, smaller family size, and modern jobs that tax mental rather than physical abilities, among other things.

neural plasticity (see page 381)

The brain undergoes a great deal of change across the life span – particularly between infancy and adolescence. Neural plasticity refers to changes in neuronal circuitry often associated with maturation, environmental adaptation, and modulation by experience, which may lead to learning and behavioural changes. Research on meditation suggests that long-term meditation practices lead to changes in levels of cortical activity in brain regions associated with attention, depression, anxiety, and anger.

problem-finding (see page 395)

Highly creative individuals are often skilled in problem-finding. They are able to identify a useful problem that needs fixing or they are able to look at the problem in a unique way, one that leads to a better solution. A very straightforward example of problem-finding can be observed when students choose project topics: some spend time conducting literature searches and mulling things over before choosing; others dive right into something that came up last class. Which projects turn out better?

prodigies (see page 392)

A prodigy performs at an expert level at an unexpectedly young age. Mozart was composing symphonies from the age of five. Magnus Carlsen became a chess grand master at the age of 13. Carl Friedrich Gauss could perform complicated arithmetic at the age of three.

10-year rule (see page 394)

The ten-year rule is the hypothesis that roughly ten years of intense practice is necessary in order to become an expert in a domain. We have probably all heard of someone like Elton John described "as a musical genius," which implies that the person came by their talent naturally. In actuality, if you were to speak to Elton John, he would probably describe how he went through many hours across many years of intense training and practice. The ten-year rule works out to about 10,000 hours of practice.

ur-song (see page 392)

Some theorists, such as Bernstein, believe that music is an innate ability that all children possess and that, even without exposure to music, all children would spontaneously sing a first song, the ur-song, consisting of the same musical notes. Carl Jung believed that the ur-song would be part of the collective unconscious—the unconscious that consisted of archived memories of our ancestors. Gardner suggests there is no empirical evidence to support the existence of the ur-song.

Discussion and Debate Ideas

1. Discuss the nature of creativity. Is it something that can be taught? If so, then how, specifically, could we foster the formation of creative ideas? If it is possible to cultivate creativity, can the same be said for intelligence? Is the point of education to teach students to be more intelligent? Or is the point to help reveal gifts that are already there?

2. Howard Gardner has proposed that each of his intelligence types is associated with specific vocations. For example, if you have very high musical intelligence, you might become a musician; if you have great math skills, you might become an engineer or an accountant. As a group, have students come up with ideas for what may be missing from Gardner's list, then have them consider whether the list includes things that don't really belong (or that some belong more than others). One could argue that there is a lot left out—why not include "debating skill" (the ability to make a good argument, which might lead to becoming a lawyer) or "humour skill" (the ability to make people laugh, which could lead to becoming a comedian). Of course, if too much is included in the list, then the concept of intelligence loses meaning.

3. It is difficult, if not impossible, to construct an intelligence test that is completely free of bias against certain groups of people. Have the class consider the following question from the Wechsler test of intelligence: What is the thing to do if you find an envelope in the street that is sealed and addressed and has a new stamp?

   The only answer that receives a full two points is "mail it or return it to the post office." If you say you'd recognize that it belongs to someone else and give it to, say, a police officer, one point is awarded. "Open it" gets zero points. Opening it is not morally acceptable in our society, but is it an unintelligent thing to do? It might be a very smart thing to do—maybe there is cash in the envelope. It is a morally loaded question.

   The Raven Progressive Matrices test has been suggested as a moral/education/culture-free alternative. Is it?

4. Encourage students to think creatively. Here is a simple question that can inspire a lot of creativity: What can you use a newspaper for? One could argue that a truly creative idea is one that is both useful and novel. Using a newspaper the read the news is useful, but not novel. Using a newspaper as a soccer ball is novel, but not useful. Give out a prize for the most creative idea. Here's one creative example: a newspaper can be used to compose a ransom note (by cutting out the letters).

5. Have students think of a person who displays each of Gardner's Multiple Intelligences. Do you think that our culture values any of these components more than the others? Why or why not? Do the same for the components in Sternberg's Triarchic theory of intelligence: creative, analytical, and practical.

6. In 1996-97, the Baby Einstein multimedia products were introduced claiming they increased infants' intelligence. Disney later purchased the company and expanded to include toys. Research suggests that these programs do not increase language development as much as contact with the parents. Discuss the differences between interactions with a video and with a real person that might influence intelligence and language development.

7. Have students speculate on the possibility of removing one entire hemisphere of the brain. Once you establish that a hemispherectomy can be done, have them speculate what life would be like for someone who has to have this radical surgery performed. Following the discussion, show them the following video: The Phenomenon of Neuroplasticity – the story of Jodi Miller a nine-year old who underwent a hemispherectomy.
https://www.youtube.com/watch?v=rDTiZpPyqRk

8. There is a great deal of advertising of brain-training games (e.g., Luminosity) that claim to increase your intelligence on certain types of tasks. Discuss the validity of these games and the use-it-or-lose-it approach to intelligence.

9. Discuss the reality or lack of reality of "baby brain syndrome": the belief that pregnant women or new mothers experience a cognitive decline. Discuss biological factors that might temporarily affect working memory and attention (the two factors reported to be affected most), such as hormonal changes, and environmental factors, such as sleep deprivation and the stress of coping with a major life change.

10. Discuss the Mozart effect, which refers to some research findings that suggest that early childhood exposure to the music of Mozart increases cognitive development. In fact, meta-analyses have shown that there is either a null effect or a very short-term effect on spatial tasks that seem to be more related to mood and arousal levels than any improvement in cognitive ability.

Further Reading, Media Suggestions, and Teaching Aids

1. **Gladwell, M. 2008. *Outliers: The Story of Success*, Little, Brown and Company.**

Outliers is a fascinating account of the origin of success. There is a tendency to assume that extraordinarily successful people are innately spectacularly talented and/or singularly hard-working

and that they reach success through their own actions. The book examines specific success stories and emphasizes the importance of practice and a supportive environment (i.e., factors *other than* individual intelligence and creativity).

2. **Operation Span Task:**
   http://www.millisecond.com/download/samples/v3/OSPAN/default.aspx

   Inquisit Task Library has an interactive version of the operation span task, OSPAN (click on "View Demo").

3. **Test Your Creativity:**
   http://99u.com/articles/7160/Test-Your-Creativity-5-Classic-Creative-Challenges

   This site provides a list (with examples) of five of the most commonly used tests of creativity.

4. **Stephen Wiltshire draws Rome from memory:**
   https://www.youtube.com/watch?v=jVqRT_kCOLI

   Stephen Wiltshire is a 33 year-old man with autism. Despite his intellectual disabilities he is often called the "human camera" as he has the ability to draw panoramic views of cities in exquisitely accurate detail after only seeing the view for a very short period of time.

5. **The Psych Files: Creativity and "There I Fixed It"**
   http://www.thepsychfiles.com/2011/09/creativity-and-there-i-fixed-it-site/

   Students will enjoy this site that demonstrates how creativity is the opposite of functional fixedness. The site highlights seven uses for everyday objects that are examples of "thinking outside the box".

6. **James Flynn: Why our IQ levels are higher than our grandparents.**
   http://www.ted.com/talks/james_flynn_why_our_iq_levels_are_higher_than_our_grandparents

   In this interesting TED talk, James Flynn discusses the Flynn Effect and the factors that might explain why IQ scores are rising. An interesting talk relates to the development of intelligence as well as the concept of theory of mind.

Homework or Study Questions

1. **Describe Spearman's notion of *g*. Describe Kanazawa's theory of the evolution of *g*.**

   Spearman noted that scores on a variety of mental tests were correlated and he inferred that there must be a general mental factor (*g*) that affects one's performance on all cognitive tasks. He also noted that intellectual performance was sometimes inconsistent; the correlation is not perfect. Spearman proposed that intellectual performance also has specific components that vary depending on the task. Spearman conceived of *g* as the amount of mental energy that an individ-

ual has available to them. This mental energy is non-specific and can be directed toward any specific ability.

Kanazawa's theory distinguishes between dedicated intelligence and improvisational intelligence. Dedicated intelligence involves domain-specific modules that are hypothesized that may have evolved to solve recurring problems. One example is the language acquisition device (described in Chapter 9). Improvisational intelligence is proposed to have evolved to deal with relatively unique, unpredictable problems—those that require flexibility rather than preprogramming. Improvisational intelligence, according to Kanazawa, is *g*.

2. What are some possible explanations for the Flynn effect?

In industrialized countries, nutrition has improved since the 1930s. Nutrition is crucially important for brain growth and neurological functioning so improvements in nutrition have contributed to increased intelligence. Improvements in overall health (including, for example, treatments for infections) also tend to lead to higher levels of intelligence. Quantity and quality of education has improved since the 1930s as well. Not surprisingly, that shows itself in improved intelligence test scores. There is a similarity between the tasks that children are given in school and the tasks included in intelligence tests; exposure and practice of those tasks in school can lead to increased scores. Environmental complexity has increased dramatically over the last century: people are exposed to vast amounts of visual media. Exposure to and interaction with computers, television, video games, and so on, may improve various aspects of cognitive processing.

3. List three of Gardner's criteria for the identification of a separate intelligence.

First, a separate intelligence will have a symbol system for representing what we know. Mathematics uses numbers, music uses notes, drawing uses visual arrays. Second, for a separate intelligence, there exist prodigies—individuals who are preternaturally talented in that realm. Third, a separate intelligence has a distinctive developmental history. For example, spoken language develops very quickly in almost all human beings. Compare that to mathematical skills—most individuals can count and do basic math, but very few progress to an understanding of higher mathematics with a great deal of education.

4. How does Simonton explain Price's law?

Price's law provides an approximate description of productivity distribution: half of the contributions in a field will be produced by the square root of the total number of workers in the field. Half of the creative work is done by a minority of the workers. Simonton's explanation is that the relatively few very productive people have more mental elements available to them. With more available mental elements, more combinations between elements are possible. Useful configurations of elements are more likely to be arrived at by people who are able to generate many permutations. Creative potential, then, is high in only a relatively small number of workers.

5. Describe the major contribution of Binet and Simon to our understanding of intelligence. How did Terman change this?

Binet and Simon were the first to attempt to distinguish between children of normal and subnormal intelligence. They developed an intelligence scale based on the concept of mental age,

which was the age at which the child performed rather than their chronological age. Terman later took the idea of mental age and created the first IQ score by taking the mental age, dividing it by the chronological age and multiplying it by 100.

6. **Compare the concept of *g* to working memory.**

   Some researchers believe that working memory and *g* are the same thing. This is based on comparisons between Spearman's concept of fluid intelligence and the central executive function of working memory. Both are cognitive systems responsible for long-term storage of information.

7. **Summarize Sternberg's theory of successful intelligence.**

   Sternberg suggests that metacomponents, performance components, and knowledge acquisition underlie intelligence. He also believed that intelligence consists of three different content areas including analytical, creative, and practical intelligence. Analytic intelligence is what traditional IQ tests measure, creative intelligence is the ability to reason using novel concepts, and practical intelligence is used in familiar situations that are non-academic.

8. **According to Garlick, what is the relationship between *g* and neural plasticity?**

   Garlick believed that neural plasticity underlies *g*. He also believed that neural plasticity determined an individual's ability to adapt to changes in the environment by forming or altering neural connections. He suggested that plasticity was determined by genetics. Children lower in neural plasticity would be limited in their intellectual development as determined by exposure to appropriate environmental stimulation.

9. **Briefly describe the relationship between creativity and problem-finding, blind variations, and, remote associations.**

   Getzels suggested that problem-finding, the ability to discover new problems, and their methods and solutions required creativity, and that a creative solution is determined by the way the problem is formulated. Blind variation is dependent upon creativity as it requires the generation of alternative problem solutions without foresight. Lastly, creative people are able to generate more remote associations than non-creative individuals.

Suggestions for Research Paper Topics

1. With reference to the literature, make the case that working memory capacity is a better indicator of intelligence than standard IQ tests.

2. Some have argued that true genius is being able to see connections between constructs—connections that are not apparent to most people. Is there any scientific evidence for such an argument?

3. Are individual differences in intelligence and individual differences in neural plasticity correlated? Review the evidence.

4. Conduct a literature search to answer the following question: What is the long-term prognosis of child prodigies? Do they tend to maintain high performance throughout adulthood?

5. Savant syndrome is a condition where a person with a severe intellectual disability (often autism) exhibits a profound capability in one area, such as art. This is often used as an example that supports Gardner's theory of multiple intelligences. Interestingly, persons with autism are often described as being impaired on measures of creativity. Review the literature on savant syndrome and explain why this paradox exists. Where does the creativity of a savant come from?

6. Do animals possess intelligence? Consider the debate from the perspective of both Gardner and Sternberg's definitions of intelligence.

7. Consider the nature-nurture debate of the development of intelligence by reviewing the literature on reaction range—the idea that we have a limited range of intellectual potential that is determined by genetics, but where we fall within that range is determined by environmental factors.

8. Is there an age limit on neuroplasticity? Researchers used to believe that neuroplasticity and rewiring of the brain traumatic injury only occurred in children under the age of five. This age limit has gradually increased as we learn more and more about the brain. Examine the current theory and discuss what factors might influence neuroplasticity after brain injury.