The Power of Pictograms: a study and guide on how to create inclusive navigational signage using pictograms to address low situational literacy

by

Alisha Kamran

Submitted to OCAD University in partial fulfillment of the requirements for the degree of Master of Design in Inclusive Design

Toronto, Ontario, Canada, 2021

“Words divide, pictures unite.”

– *Otto and Marie Neurath*

Abstract

The transmission of navigational language is increasingly communicated by icons and visual indices. The research in this paper will examine the question of how to design inclusive navigational signage using pictograms to address the differing literacy levels in the local language and script for urban public transportation. Through theory of semiotic analysis and examining international and historical case studies, principles of inclusive design will inform a signage system, which will be used to create a new proposed guideline. This guideline will inform digitally-implemented navigation communication in urban settings, such as Toronto's Transit Commission (TTC) subway system and underground walkway, the PATH. Findings are used as case studies to illustrate the application of the system. The physical environment in which the pictogram systems are created for must be specific to that environment only and cannot be interchangeable, which may include cultural implications. Recognizing that this nuance exists, inclusive navigational signage will need to include supplemental modes of communication, such as QR codes, to address those knowledge gaps for individuals with low situational literacy who may not know the local language or culture.

Dedication

I would like to dedicate this research project to my mom and dad, Seemi and Kamran, for their support in constantly providing me with the emotional and spiritual strength to keep pushing forward, and to my friends and family for their inspiring words of advice.

I also thank my Principal Advisor, Richard Hunt, for his patience over the past three years, for always understanding and for laughing with me throughout the entire process. We did it.

Table of Contents

List of Figures

Introduction

The idea of navigational communication has become increasingly important as the need for accessibility and inclusive design develops across the world. Public systems of transportation, such as the Toronto Transit Commission (TTC), are large and at least somewhat publicly funded, yet they may lack simple, unified and accessible signage across their various modes of transportation. In the case of the TTC, there is a wayfinding system in place, but without additional design development, it falls short of successfully serving those who may be new to the system, most particularly if they are not familiar with the English language and the roman script. Currently, its main focus appears to be addressing the aim of providing directional guidance to anglophone Ontarians who are familiar with the city of Toronto. In examining the question of how to design inclusive navigational signage, pictograms offer an approach that can be used to address the differing literacy levels in the local language and script for urban public transportation. This will allow the TTC to create a more robust system that caters to a larger demographic. There are many universal examples that exist today, such as airport signage and Olympic Games pictograms, and it would be a disservice to not determine the affordances of those pictogram systems to see how they can be mapped onto the TTC's current subway system and or the PATH walkway. Additionally, by leveraging QR codes, which have the properties of a graphical item, one can provide alternate forms of communication to cater to those who may have low situational literacy. A proposed design solution would be to utilize the affordances of international pictogram systems and QR codes, and apply inclusive design principles to update the current TTC and PATH signage to ensure that it caters to a larger demographic with varying literacy levels.

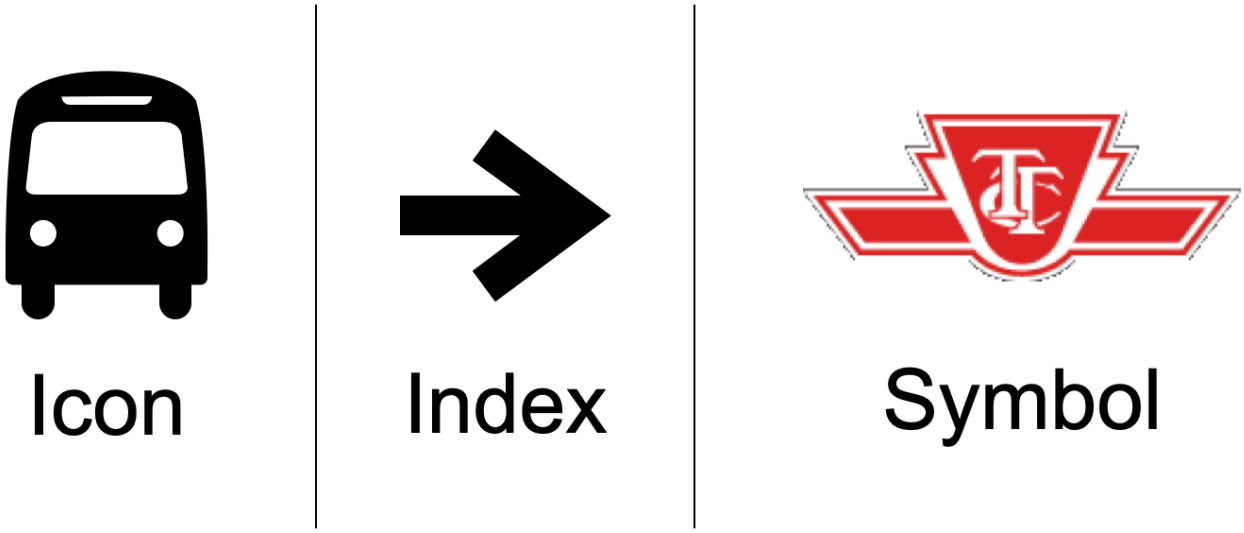
The Theory of Semiotics in The Context of Navigational Symbols

The theory of semiotics dates back to the 19th century when Ferdinand de Saussure, founder of semiotics (which he called semiology), considered the meanings of signs. He

proposed that the first part is the signifier (the form which the sign takes, such as a stop sign, or facial representations like emojis) and the second part being the signified (the concept that is being represented such as the word “stop” in a stop sign, or the emotion represented by the emoji). Subsequently, Charles Sanders Peirce went on to categorize signs as being one of three types: icon, index or symbol. An icon has a physical resemblance to what it represents, an index is something that shows evidence of what is being represented, and a symbol bears no resemblance to the thing it represents but rather it is a connection that is culturally learned (Bradley, 2016). The figure below depicts an example for each sign.

Figure 1

Icon, Index and Symbol



In the figure above, the bus communicates the idea of the vehicle because it resembles its physical form and there is little to no room for interpretation, thus allowing it to be something that can be easily deciphered. The indexical graphic in this case is the directional arrow. This index typically may indicate the way to proceed, or can be paired with another icon, symbol or text on signage. Airports or public transportation systems are good examples because directional arrows on those signages represent a path an individual must take if they want to go to a

specific place or see a specific thing. The success of directional arrows relies on the user making the connection between the two visuals. Lastly, we have the symbol of the TTC. This symbol has no resemblance to what it is depicting. For someone to understand what this symbol means, they must have prior knowledge of Toronto's transit system, such as having seen it before, ridden this transportation system or otherwise learned its meaning.

When looking at design for user interface, Yvonne Roger, professor and director of University College London Interaction Centre, examined the increasing usage of these signs and created a classification system to facilitate greater understanding.

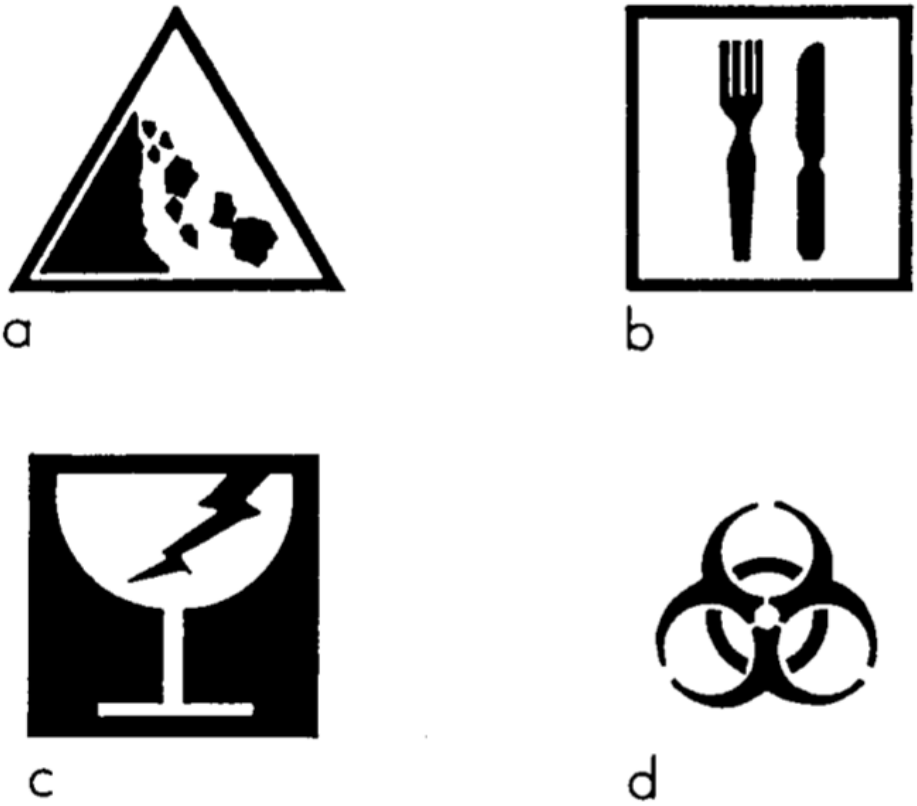
It is important to note that what Rogers refers to as icon is what Peirce refers to as sign: each has different definitions of symbolic and or symbols.

Rogers asserts that the "form of an icon is the type of representation that is used in the depiction" (1989, p.134). Furthermore, the form can be categorized in one of the following four concepts: resemblance, exemplar, symbolic, or arbitrary, with the figure below providing examples of each.

> "Resemblance icons [a] are those which depict the underlying referent through analogous image…exemplar icons [b] are one which serves as a typical example for a general class of objects…symbolic icons [c] are used to convey the underlying referent at a higher level of abstraction than the image…[and] an arbitrary icon [d] is one that is constructed that bears no relationship to the referent; hence the association must be learned" (Yvonne, 1989, p.136).

Figure 2

Different Forms of an Icon



Rogers, Y. (1989) Icon Design for the User Interface. In D.J. Oborne (ed.) *International Reviews of Ergonomics: 3*. London, Taylor and Francis, 129-155. PDF version PDF version

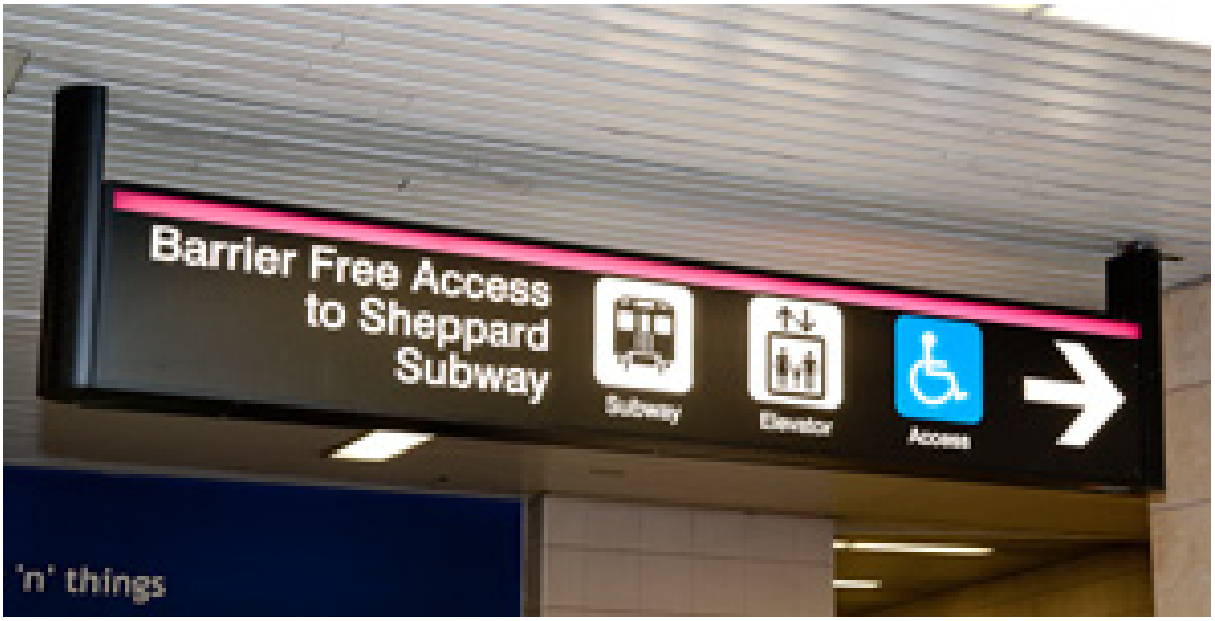
It appears that Rogers' icon categorization was influenced by Peirce's sign categorization. Resemblance icons would be Peirce's icons, and arbitrary icons would be Peirce's symbols. The main difference between the two would be that Rogers further classifies Pierces' index into two separate categories: exemplar and arbitrary. The separation of index allows for more room to better understand the universality of the icon i.e., how abstract is the concept being depicted? On the other hand, when Rogers classifies index as two separate categories, it can be argued that the differences may be subjective. Whether what is being represented is of face value or has some element of abstraction to it is individual to the interpreter. Referring back to figure 1's example of index, though it is an image of an arrow, the interpretation is usually taken as

indicating a direction. It could mean *go left*, which is an abstract concept, but it could also mean *go south*, which is another form of direction.

When examining the theory of semiotics and its application to pictogram systems for wayfinding, it is important to recognize that a diverse and multicultural audience will be utilizing and interacting with this pictorial form of information. The more universally an icon can be understood, the better. When examining figure 3 below, one can see how the TTC subway station utilizes resemblance icons to depict subway and wheelchair accessibility access. These resemblance icons are effective because it allows a user to understand that both the subway and wheelchair accessibility are towards the right side of this area.

Figure 3

TTC's Easier Access Program



Projects: Current and ongoing development. TTC. (n.d.).

https://www.ttc.ca/About_the_TTC/Projects/index.jsp.

With reference to Roger's classification of icons, the more literal the design, the less likelihood there is for different interpretations. Therefore, when trying to create universally understood

icons, one will prefer resemblance or exemplar icons, as they have a strong likeliness to the object or concept in real life. Of course, this is not always possible as some actions or concepts are hard to represent visually. In figure 3, one can also see a pictogram depicting elevators. The idea of communicating vertical movement through a static image would be considered as Roger's symbolic icon, as it is trying to communicate an abstract concept. The reason why this image may be effective in this situation is because the arrows above the box show an upwards and downwards motion that could allude to going up or down. The three figures in the box then mean the box is physically moving up and down. By process of elimination, this is Roger's symbolic icon and a hybrid between Peirce's icon (the elevator) and index (the directional arrows).

Figure 4

Ataturk Airport Signage Located in Turkey

Designworkplan. (n.d.). Airport signage. designworkplan. https://www.designworkplan.com/read/airport-signage-photo-inspiration.

When looking at this specific set of airport icons, in figure 4 at Ataturk airport, located in Istanbul, one can see how culture undermines the effectiveness of the universality for some of

these pictograms. Utilizing Rogers' icon classification, the washroom representation would be an example of an exemplar icon; a typical example of the universal washroom icon with small stylistic design changes to the form of the figures. When referencing Pierce's classification, the washroom visual depicts a man and a woman in a box but, due to their widespread use, these figures have become more of an index/symbol. For the other visual, Rogers would classify the passport control image as a symbolic icon, as it is depicting the concept of an authority figure inspecting or checking. Pierce's theory would argue that it has iconic properties because it is showing an image of the person, and indexical properties, because the user has to make the connection with the purpose of the activity. Conversely, the lack of consistency in the design for this specific icon across international airport signages leaves room for interpretation. In figure 5 below, we see a similar image used to depict police. Though the designs are not identical, we still see the visual of a uniformed figure with a hat. This shows that similar pictograms will have different intentions, and presumably, interpretations in different contexts. The third visual, in figure 4, is of a crescent moon. It represents first aid, and is thus an arbitrary icon: the concept of this icon has no direct relation to what is being shown; the association must be learned. If a non-English or non-Turkish speaking individual with low situational literacy were to be at this airport, they would have no idea what the crescent moon depicts. The association that must be learned is that, in predominantly Muslim countries, things related to health emergencies, such as a first aid kit, would be depicted using the international symbol of Islam, the crescent moon. This concept is culturally local and thus the meaning is opaque for those who are not Muslim or those living outside of Muslim countries.

Figure 5

Warsaw Airport Signage Located in Poland

Designworkplan. (n.d.). Airport signage. designworkplan.

https://www.designworkplan.com/read/airport-signage-photo-inspiration.

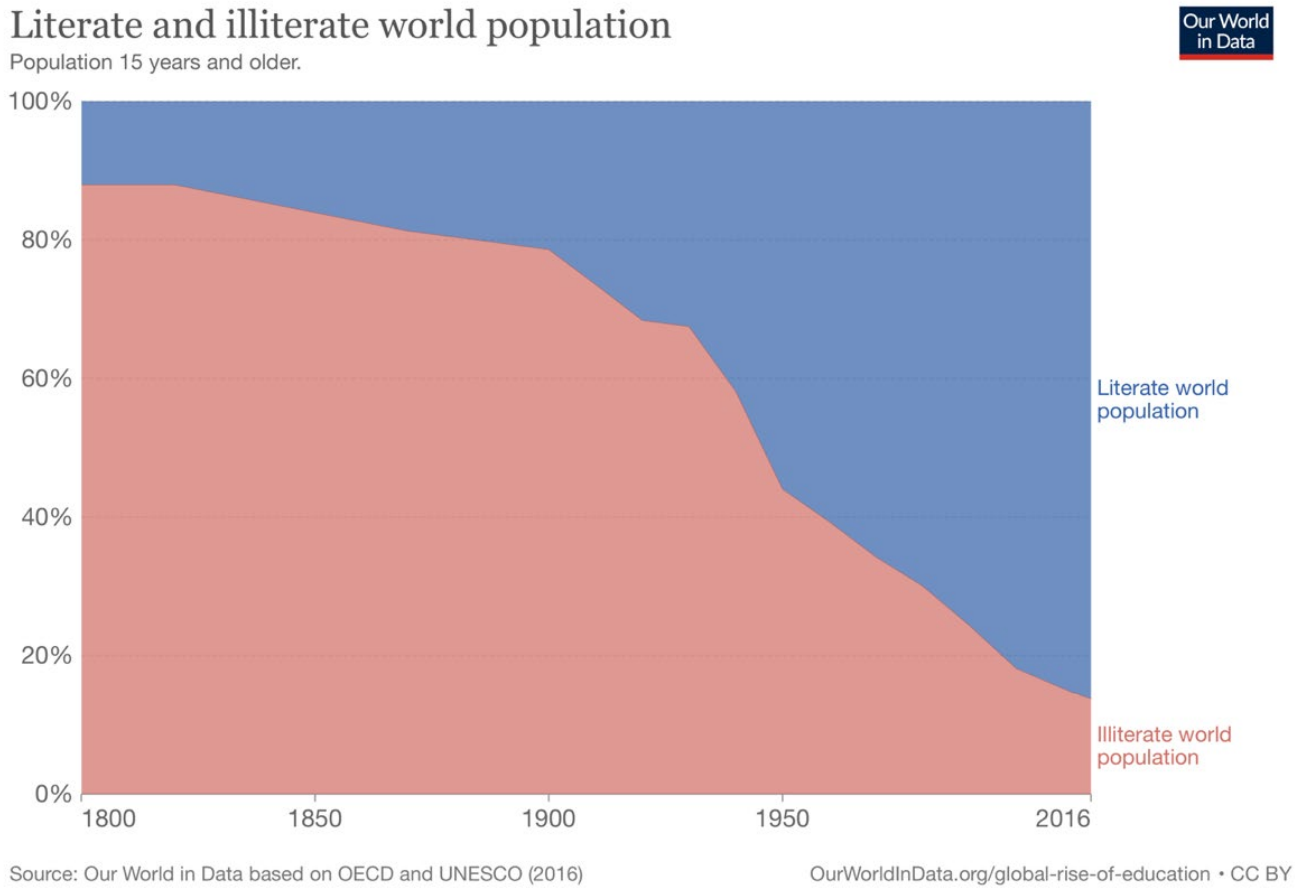
Semiotics can be applied to pictogram systems for wayfinding, but it is worth noting that the more abstract the concept being conveyed, the harder it is for the user to correctly construct an interpretation of the message. When catering to a diverse and multicultural audience, one must try to ensure, to the extent possible, that this pictorial form of information can be universally understood. If it cannot, there should be visual uniformity and supplemental systems of information, usually text as in the examples above, to provide further clarity as to what the sign means.

Literacy in a World of High Mobility: Examining Urban Contexts

Although written language is rich in information, it is limited in its effectiveness to those who can understand writing in that specific language (Zender, 2016). While literacy rates around the world have tremendously increased since the 18th century, with only 13.75% of the world illiterate as of 2016, “situational literacy” may be low for those who are travelling or living outside their original cultural context (Roser & Ortiz-Ospina, 2016).

Figure 6

Literate and Illiterate World Population



Roser, M., & Ortiz-Ospina, E. (2016). Literacy. Our World in Data. https://ourworldindata.org/literacy.

Situational literacy

The term “situational literacy” applies to the degree to which a person is able to decode messages in a particular context. It applies to cases where a literate individual in some contexts may be lacking the ability to decode a message that they need to guide their behaviour or execute a task, with a difference in culture or language often playing a role in this knowledge gap. One may be culturally sophisticated and literate in a language and script in one context but may become illiterate due to the new context and environment they are in when that individual travels (whether for tourism or immigration). As the examples above show, international airports

are a place where situational literacy is likely to be low for many travellers. Another context or environment where low situational literacy can occur is urban public transportation systems. As cities continue to become increasingly diverse, designers of navigation aids and related stakeholders need to recognize that English on its own may not be an effective way to communicate to culturally diverse groups of individuals.

For example, when examining the city of Toronto, the 2016 census findings show that 4.4% of Torontonians do not speak English or French (Statistics Canada, 2016). This means that roughly 132,700 people living in Toronto cannot speak those languages with mostly women and seniors making up this population (Vella, 2018). To believe that this 4.4% is illiterate is an assumption and oversight as they are likely to be literate in a language other than English or French. 43.9% of Torontonians identify their mother tongue as a language that is not English or French with Indo-European languages coming in at first at 21% (Statistics Canada, 2016). Separately from spoken language, different script systems also come into play as an advantage or disadvantage. Someone may not speak English or French, but they may use the roman alphabet. They will have an advantage over those who do not speak English or French and use another form of alphabet or non-alphabetic script system. As Toronto continues to diversify its multicultural landscape, it becomes more important to examine ways of overcoming situational literacy for those who may not speak English as a first language when it comes to using public transportation navigation.

Situational literacy is a problem in other environments as well and is addressed in different ways. When examining high-pressure environments where information is needed immediately, communication has been enhanced with visual or auditorial cues to address the problem of lack of situational literacy. In a joint communication journal on quality and patient safety, Welch et al. (2013) examine strategies for improving communication in the emergency department (ED). Over half of patient death or permanent injuries due to delays in treatment have occurred in the ED and further analysis shows that 84% of the root cause was

communication error (p. 279). Lacking effective communication in such dire situations is clearly a problem and the noise of this specific environment is an added barrier (Welsh et al., 2013, p. 280). A prevalent form of visual communication in the ED is pre-identified visuals to communicate a certain action. For example, to cut through the loud environment, visual signaling is used to guide medical students through cardiopulmonary resuscitation (CPR) by providing them a pulsing visual to follow. Though students may theoretically know how to perform CPR on an individual, in the moment there may be distracting environmental noise which can impair their performance. Other forms of communication, such as a pulsing visual, can enhance their ability to revive their patients. Students that have used this method performed effectively and were able to constantly maintain the desired rate of chest compressions despite the high level of artificially generated background noise (Welsh et al., 2013, p. 280). With the pulsing visual as a guide, this increased the situational literacy awareness of the medical students, allowing them to perform CPR on their patients effectively. This example clearly shows how communication barriers are addressed with visual and or auditory cues at the hospital to support workers in providing improved and immediate forms of behaviour. The findings of this research show how visuals can replace or work with other forms of communication vehicles to enhance user experience and increase situational literacy.

In terms of navigation when traveling or moving to new international cities, situational literacy is likely to be low. The reason behind this is because the individual traveling may be largely functionally illiterate, not because they cannot read or write, but rather they do not speak or read the local language, and possibly, the script.

An example that many people have experienced is that of air travel. At any airport, whether it be national or international, signage is displayed everywhere to help individuals with navigation, using pictograms to supplement or replace language. Many of these internationally recognized pictograms attempt to transcend language and cultural influences, by using generally accepted imagery and conventions with the intention of making them readable by all

visually abled users. Some of the most iconic pictograms air travellers see and need are the ones shown below: food court and washroom.

Figure 7

Airport Signage in Doha, Qatar

Designworkplan. (n.d.). Airport signage. designworkplan.

https://www.designworkplan.com/read/airport-signage-photo-inspiration.

As shown in the signs above in figure 7, any traveller would likely be able to decipher what the visual on the sign means and therefore their situational literacy, in this particular situation, would be adequate. This is probably because the effectiveness of these pictograms is largely due to the fact that they are used in environments outside of the airport all over the world. However, it is important to note that they are heavily influenced by western culture. Not all cultures use these items of cutlery, such as a fork. The representation of male and female in the washroom symbol is heteronormative, culturally specific to the western and parts of the eastern world, and the attire representing females is outdated. What makes them effective is that they have become universal and therefore are considered to be largely symbolic in nature. However, if a non-English literate individual were to navigate in an airport for the first time and need to take a connecting flight, their overall situational literacy may be low. This is because unlike the food

and washroom pictograms, there is a lack of consistency in the design for these messages. Figures 8, 9 and 10 below showcase three different examples of designs used for connecting flights or transfers that are inconsistent with the language and design method of the pictograms.

Figure 8

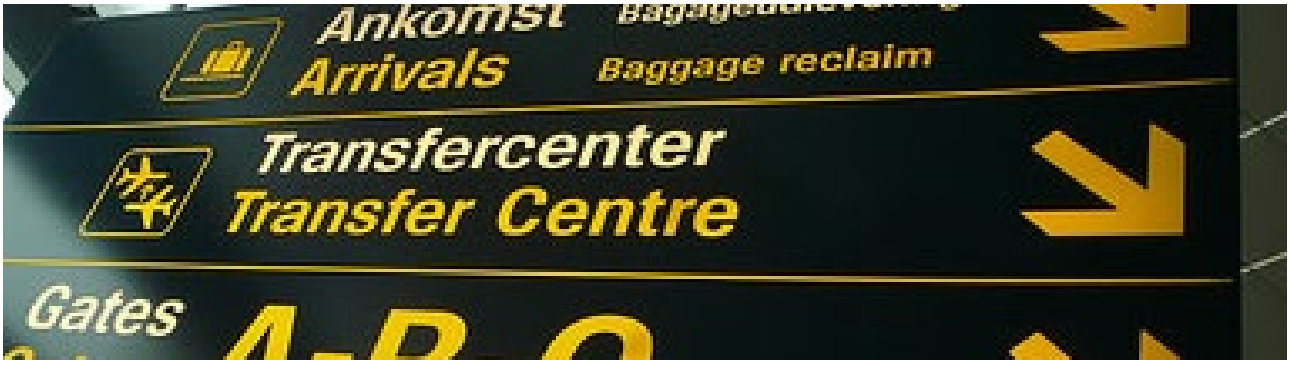
International Airport Signage in Malaysia

Designworkplan. (n.d.). Airport signage. designworkplan.

https://www.designworkplan.com/read/airport-signage-photo-inspiration.

Figure 9

International Airport Signage in Copenhagen



Designworkplan. (n.d.). Airport signage. designworkplan.

https://www.designworkplan.com/read/airport-signage-photo-inspiration.

Figure 10

International Airport Signage in Singapore

Iborntotravel. (2015, November 5). *Day 1 : Singapore – arrive at Singapore (It's National Day!)*. I Born To Travel. https://iborntotravel.wordpress.com/2015/11/09/day-1-singapore-arrive-at-singapore-its-national-day/.

When looking at the signage from the Malaysian airport (figure 8), at first glance it is hard to decipher what it means without understanding the typographic element. The two planes flying above the individual could mean departure with the individual representing a family member or loved one watching an aircraft take off. In Copenhagen's signage (figure 9), the image of two planes flying above one another does not have clear significance but might be more effective if the designer were to include arrows showing the idea of transfer. Lastly in the Singapore signage (figure 10), the dotted line circle with the two planes passing another could represent a different concept such as airplane reroute.

In this scenario, as the individual is unused to traveling, they may not know what these symbols mean, leading to them experiencing low situational literacy; but as the individual travels more, their situational literacy will increase, meaning that they will recognize that two planes in one icon could mean transfer or connecting flight. This would move the pictogram from iconic to

symbolic in terms of user perception. One can even argue by saying that the individual may become familiar with the word transfer itself as an icon or a word and know what it means. It is important to note that in both examples, these icons have been paired with language adding more prominence to the fact that visuals can replace or work with other forms of existing communication to enhance user experience and increase situational literacy.

The transmission of linguistic navigation is increasingly communicated by icons and visual indices. Visual symbols can be very useful, but they are generally interpreted into language, and language is a universal form of communication for human beings. Some of these seemingly ambiguous navigation graphics are not just seen at airports but on other modes of transportation, such as subway stations or pathways.

The History of Pictograms and the Evolution of Public Transportation Navigation

Pictograms have been used as a form of communication in the past, present and will continue to be in the future. These visual designs, typically comprised of simple line work, have played a significant role in the evolution of human culture and have been used as a means of conveying communication throughout civilization. This initial form of language may have played a role in the development of modern-day writing systems across the world and have contributed to the idea of icons and pictograms. (Team, 2015).

Figure 11

Hieroglyphs, Oracle Bone, and Wall of Pictographs

Kiger, P. J. (2021, July 26). *8 facts about Ancient Egypt's hieroglyphic writing*. History.com. https://www.history.com/news/hieroglyphics-facts-ancient-egypt.

Mark, E. (2016, April 7). *Chinese writing*. World History Encyclopedia. https://www.worldhistory.org/Chinese_Writing/.

Native American Petroglyphs & Pictographs: Drawings & Meanings. (2017, August 28). Retrieved from https://study.com/academy/lesson/native-american-petroglyphs-pictographs-drawings-meanings.html.

An early example of written language in the form of pictograms is that of Egyptian hieroglyphics. “The Egyptians first used hieroglyphs exclusively for inscriptions carved or painted on temple walls. This form of pictorial writing was also used on tombs, sheets of papyrus, wooden boards…, potsherds and fragments of limestone” (Egyptian civilization). The shortcomings of these pictograms shown in figure 11 are that while pictograms are effective at communicating objects, they are less effective at communicating concepts and actions. To be

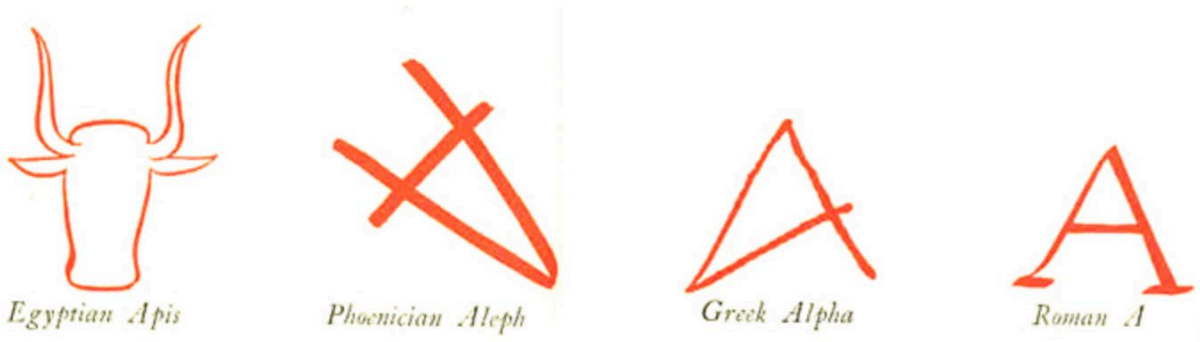
effective, there needs to be an understanding of culturally agreed upon symbols. Another example of written language in the form of pictograms is the evolution of script for Ancient Chinese writing. Jiaguwen, the earliest form of writing on oracle bones, was made up of pictographic inscriptions representing the object or concept it was wanting to convey (Mark, 2016). Again, the limitations of this script were that concepts such as “should” were hard to communicate. Like the hieroglyphics, the writing system eventually evolved into logographic, which is largely symbolic and allows for the representation of concepts and complete language. Similarly, to Jiaguwen, pictographs, which are painted symbols or images, were used by Indigenous Peoples for storytelling, narratives and, significantly, to communicate navigational information. These detailed stories ranged from depicting different kinds of travel; the zigzag mountains indicated a new destination and a bison represented successful hunting expeditions (Native American Petroglyphs & Pictographs: Drawings & Meanings, 2017). Pictographs were also used to represent a variety of different concepts such as human qualities and conveying relationships (Native American Petroglyphs & Pictographs: Drawings & Meanings, 2017).

It is interesting to note that the Greek and Roman alphabetic writing systems are an evolution of pictograms. The first alphabets depended on the use of pictograms representing concrete objects that were used to represent the sounds of language, initially representing only consonants. “Characters were pictorial, they had evolved from a relationship between their shape and the sound of what they represented” (Guaida).

“The Greeks adapted the Phoenician alphabet to their language, adding extra symbols to represent the vowels, since Greek could not be read by consonants alone” (Guaida). When they added the extra symbols, now known as vowels, they created the most accurate version of the alphabet.

Figure 12

Evolution from Pictorial to Alphabetic Writing System



Guaida, S. (n.d.). *Evolution of the Roman Alphabet*. Writing Systems: Structures for Language. Retrieved September 10, 2021, from http://www.arch.mcgill.ca/prof/sijpkes/arch374/winter2002/pssolange/roman.htm.

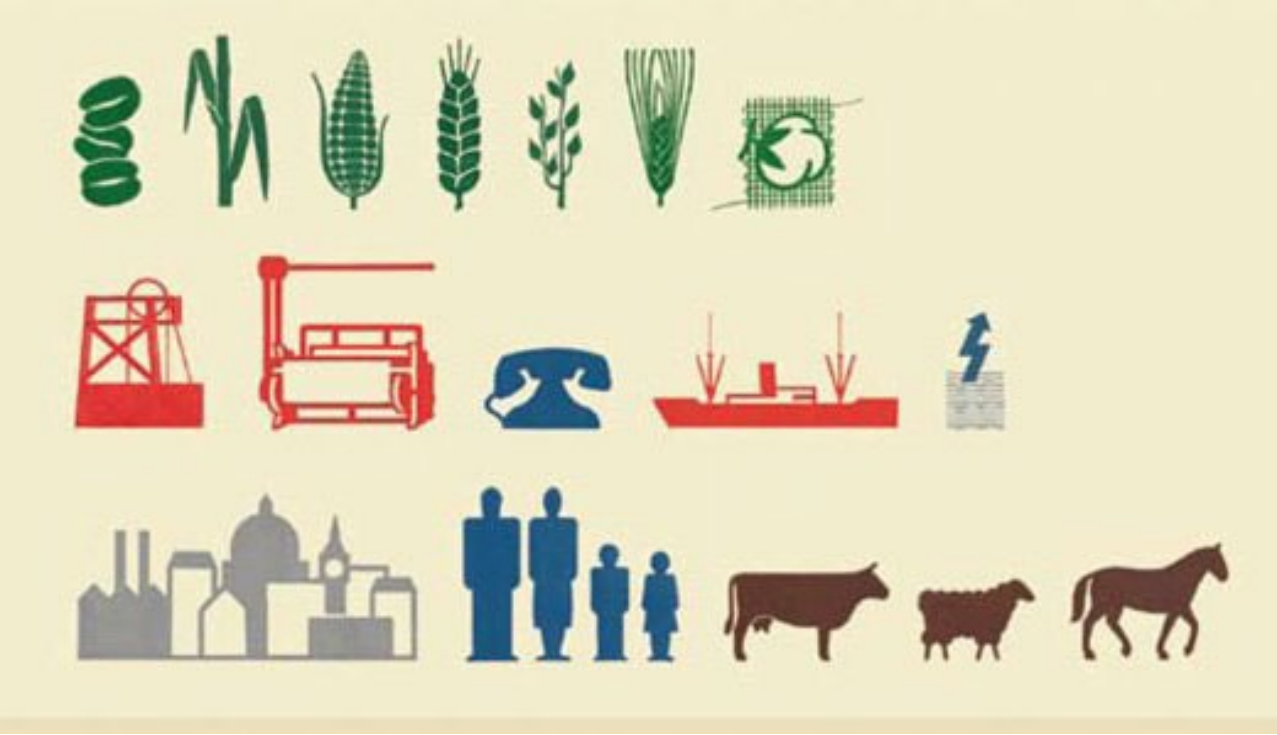
The figure above shows the evolution from the relationship between sound and what it represents. “A” is alpha in Greek but it does not mean anything in itself. The Semitic symbol “aleph”, however, means “ox”. Our modern ‘A’ is, in fact, still recognizably a (rotated) ox’s head (Guaida). The Roman alphabet derives from the Greek alphabet from which it adapted many letters and added some new ones. Thus, not only was the Greek alphabet an evolution of pictograms, but so was the Roman.

Pictograms, which represent a symbol, a real object or a figure in a schematic way, can be seen throughout society. The most successful pictograms are able to communicate to international audiences transcending culture or linguistic barriers, such as the airport example in figure 7. The works of husband-and-wife team Otto and Marie Neurath, working in the early and mid-20th century, recognized this. “Words divide, pictures unite” was the slogan of the couple who dreamed of a utopian world where communication would be streamlined through universal symbols (Jeffries, 2019). They had a vision of creating a universal language; something that

would not only help out the uneducated working class with understanding dense statistics and words, but to also break down cultural barriers (Hammond, 2013). These inventive revolutionaries created the Isotype concept (International System of Typographic Picture Education), which was used to refer to the pictographic language they developed to educate children and the public on complicated topics through visual icons (Jeffries, 2019). Otto's focus was on using a simple combination of symbols, drawn from his childhood inspiration of hieroglyphics, and colours to showcase abstract data in clear ways while Marie did the same through several children's books devoted to science education.

Figure 13

From Hieroglyphics to Isotype



Hammond, K. (2013, August 2). *Otto Neurath and the Untold History of the Infographic*. Nebo. Retrieved September 9, 2021, from https://www.neboagency.com/blog/otto-neurath-and-the-untold-history-of-the-infographic/.

Figure 13 above shows how Otto would take several forms of abstract information and render them to Isotype. The image above is part of Otto's book called *From Hieroglyphics to Isotype.* This specific series of icons and symbols show the reader how abstract concepts such as livestock, telephone and food can be depicted through imagery that transcends culture. For example, when further examining the telephone, it is iconic in nature though it depicts what the object would look like in the mid 1900s. The icon can be used as signage to help individuals determine where a telephone booth is located, or it could be used before or after someone's telephone number. It is important to note that though it is universal and transcends culture, it may not transcend time. As technology continues to develop throughout the years, so did the icon of a telephone. By creating Isotype, Otto tried to communicate in a form that was intended to be understood across the globe. It was clear that back then, the Neurath's were pioneers in data visualization through visual icons.

In their book, *Design: The Key Concepts,* Huppatz tells us that, "starting in the mid-1970s, manufacturers and consumers needed symbols for an increasingly global market for technological machines such as stereos, washing machines, and automobiles" (2020, p.21). In a largely literate world, they have the most application in international cultural contexts. A widely used international form of pictograms are those used on computers. The evolution of these pictograms started back in 1981 when Xerox created the first consumer graphical user interface (GUI) computer designed around the office metaphor; the best examples being calculator, files, trash and document because they most resemble the real-life object they are referring to (McInnes, 2010). McInnes then shows (see Appendix A) that over the years, Apple and Windows have further developed the GUI to create realistic pictograms symbolizing the function they do (2010). One can see how the 1984 design for the Apple Macintosh 1.0 was a turning point in the design approach where the pictograms look more visually complex versus pixelated or graphic. A stride towards making the pictograms further resemble life-like objects was done in

1991 through the Macintosh System 7 where they added colour to the pictograms, which allows the pictogram to have more characteristics of the object it is representing. It is interesting to see that however when the 2001 Windows XP launched, the pictograms were starting to shift from iconic to symbolic.

Figure 14

Image of 2001 Windows XP

McInnes, K. (2010, July 18). *Know your Icons, Part 1: A Brief history of computer icons*. Design & Illustration Envato Tuts+. https://design.tutsplus.com/articles/know-your-icons-part-1-a-brief-history-of-computer-icons--psd-9805.

Concepts such as system preferences and display were appearing but as they are abstract ideas, they were often no longer providing any resemblance to what they were intending to represent. Users now needed to click on those symbols to learn what they mean, leading them to frequently forget what function or purpose it serves, until they learned the symbolism. It is interesting to note that some icons are not specific to a brand. For example, the question mark

(representing help), the globe (representing the internet), the cursor (representing the pointer), the gear wheel (representing system preferences) and even the floppy disk (representing save) are icons that transcend brands and companies, and still exist to this day. The development of these icons has come quite far, but it is possible that some of them have become overdeveloped rendering them uninterpretable. They have evolved from icons (in the Peircian sense) to symbols.

A historical example of navigation using visual form is seen in the inukshuk structures that were used in North America by Indigenous Peoples of the Inuit Nation.

Figure 15

Stone Inukshuk

Government of Canada. Canada.ca. (2017, October 2). https://www.canada.ca/en/canadian-heritage/services/art-monuments/public-art/inukshuk.html.

"An inukshuk…is a figure made of piled stones or boulders constructed to communicate with humans throughout the Arctic" (Hallendy, 2020). The inukshuk served many purposes, such as signifying a change of direction from an intended course and directing travellers by acting as indicators. If someone inexperienced were to go on a trip they would benefit from these navigational aids: "someone who is familiar with the area being traversed shares information on the appearance and message of particularly significant inukshuks" (Hallendy, 2020). This is because the individual who is knowledgeable about these forms of indicators know that they can communicate vital information like depth of snow, if an area is safe for crossing, and more. Inukshuk are also used as a navigational aid in the sense that they can indicate the safest way to get home, identify areas of significance such as ceremonial sites, and can serve as a warning when entering major transition points between water and land routes (Hallendy, 2020). The inukshuk is related to the directional arrows used in transportation navigational communication because of its purpose of signifying change in direction. One can see this in current built environments, such as the TTC subway stations, where directional arrows are used to orient and direct users. These directional arrows are beneficial to those who are unfamiliar with a specific subway station or the TTC subway stations in general.

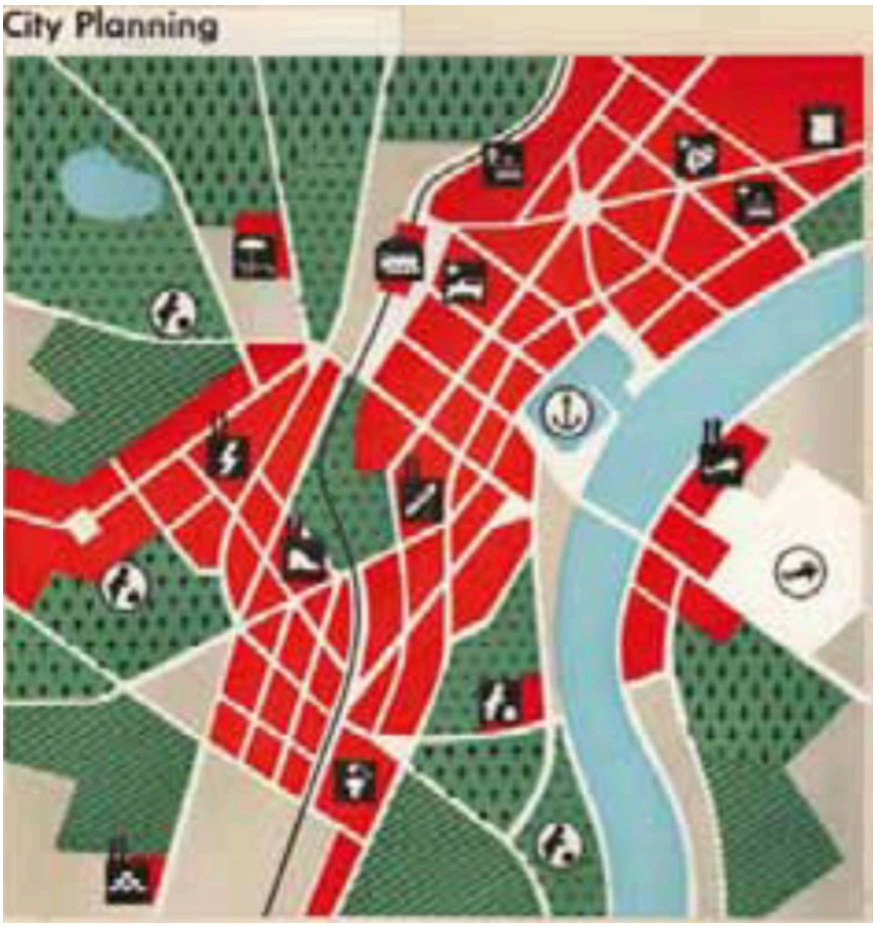
When looking at another form of navigational communication in the modern-day transportation context, one can examine international airports. These facilities can sometimes appear maze-like and intimidating to anyone with low situational literacy, a common occurrence in airports, where many travellers may be unused to the environment. Even if an individual were to speak the local dialect, there still may be a daunting element in exploring unknown areas with need of knowledge on how to get from point A to B, especially when time is of the essence.

Navigational communication or wayfinding is an area dedicated to developing and implementing orientation signage by which allows individuals to navigate such places (Huppatz, 2020, p.31).

To better understand public transportation navigation, one must first understand the history of mapping and wayfinding. During the 1930's Otto Neurath became known for his representational maps. "He revolutionized the discipline of chart making by finding a way to create picture statistics and quantitative maps that were accessible to a larger public" (Hochhäusl, 2013). He wanted to depict information in an unbiased way, but his main aim was to catalogue universal signs throughout his maps. To Otto, what made up a map was not the physical environment itself, but rather the economic relationships. "Furthermore, they had to be connected via transportation routes, which he also saw as interwoven with sociological and anthropological components" (Hochhäusl, 2013). Cities were where cultural exchanges took place. The urban landscape was what Otto saw as the unity between architecture and organizations. One of his most famous maps (figure 16), *City Planning*, was ground-breaking as it consisted of pictograms, patterns made of symbols and spatial parameters – well before the time of using pictograms as a widespread form of navigational communication in modern urban contexts.

Figure 16

City Planning - 1937 Map



Hochhäusl, S. (2013). Otto Neurath: Mapping the City as a Social Fact?: . In R. Heinrich, E. Nemeth, W. Pichler & D. Wagner (Ed.), *Volume 2 Volume 2* (pp. 99-136). Berlin, Boston: De Gruyter. https://doi.org/10.1515/9783110330496.99

Otto's maps were well ahead of their time as they efficiently bridged the gap between icon and plan by "allowing the symbol not only to signify quantities within space but to actually become space when multiplied" (Hochhäusl, 2013). His maps also communicated information to the uneducated, thus bridging situational literacy gaps.

As cities and towns grew at a rapid pace in the 20th century, the transit systems of urban areas were becoming large and complex, leading to a high demand and need for navigational communication or wayfinding. In Lu's research on *Creating a Successful Wayfinding System: Lessons Learned from Springfield, Massachusetts,* (2016, p.15) they categorize the

development of wayfinding during this period into three eras: the first era (1960s-1970s), the second era (late 1970s-1990s), and the third era (mid 1990s – today).

The first era, as Yu explains, shows the initial foundation and conceptualization of wayfinding, which was done through cognitive semiotics; where researchers explored the ways in which information was processed and how those individuals naturally found their way through cognitive mapping and spatial orientation (2016, p.15). During this time, Kevin Lynch, author of *The Image of the City* coined the term “wayfinding” where he said that people analyze their surroundings by forming their own cognitive maps, “which are referrable to physical forms [and] can conveniently be classified into five types of elements: paths, edges, districts, nodes, and landmarks” (1960, p.46). Cognitive mapping proposes that the human brain builds a unified representation of the spatial environment to support memory and guide future action (Epstein et al., 2017). This is why many people find it increasingly easy to navigate areas to which they have been exposed to a multitude of times and hence why it is important to understand cognitive processes as they apply to wayfinding.

According to the Society of Experimental Graphic Design (SEGD), about 20 years after the time that Lynch expounded his theory of wayfinding, the Amsterdam Schiphol Airport introduced the first ever colour-coded sign system in 1967 with the concept of “passengers first”, stripping down any nonessential information for their audience and visually classifying the information by colour, which was later named as the Schiphol Standard (2013). In the figure below, one can see how simple the colour coding appears to be with yellow representing airport communication (like gates and connecting flights), blue representing non-essential (like restaurants and shopping centres), grey representing essentials (like washrooms) and green representing emergency exits.

Figure 17

Sample of the Schiphol Standard Signage

Airport wayfinding and graphics. SEGD. (2013, December 13). https://segd.org/airport-wayfinding-and-graphics.

The second era as Yu points out, sees a further development of the concept of spatial orientation (2016, p. 16). In the late 70's, an architect and environmental psychologist by the name of Romedi Passini introduced the idea of wayfinding as a major design issue. Though "the layout and the circulation routes define the wayfinding problems people will have to

solve…architectural and graphic communication provide the user with the information to solve the imposed problems" (1996). Passini is arguing that simple wayfinding may not be a matter simply of text, instead, other forms of graphic communication, such as pictograms, are needed to help individuals with wayfinding. In this era as well, two decades after the initial version of the Schiphol Standard, the SEGD states that a designer by the name of Paul Mijksenaar further expanded on the Schiphol Standard for airports by adding pictograms, refining the arrows and adopting a legible typeface called Frutiger (2013); this was specifically designed for signage at Charles de Gaulle Airport in Paris and was released in 1976. Frutiger is one of the many fonts where each individual character is quickly and easily recognizable and is largely known for being legible from a large variety of distances and angles making it the ideal font for signages and display work (Frutiger® font FAMILY Typeface Story).

Figure 18

Frutiger Typeface

Lucente, J. (2015, February 24). *The story of Frutiger: Typeface of the airport*. OpenLab at City Tech. https://openlab.citytech.cuny.edu/type/2015/02/24/the-story-of-frutiger-typeface-of-the-airport/.

In the third era, Yu sees the concepts of wayfinding and spatial orientation further developing where researchers are focusing on how people acquire knowledge versus the environment itself; specifically new phases of experimental wayfinding that incorporate environmental psychology, space cognition, and space syntax research (2016, p.16). “Perhaps more than anything else, the current era’s extraordinary interest in wayfinding especially as it relates to design and technology, indicates that the field has a range of needs and challenges that provide many opportunities for further study” (Yu, 2016, p.16). The Society of Experimental Graphic Design say that Miijksenaar continues to refine the system at Schiphol and other international airports such as Abu Dhabi, Frankfurt, and Athens (2013).

Pictograms as a Form of Signage

Like any form of navigational communication, the “combination of typography, colours, forms, and size [are] essential in creating a user-friendly navigation system” such as signage” (Huppatz, 2020). These forms of communication design help individuals navigate the physical environment, with many of them using a combination of different communication vehicles such as images, symbols, and/or text. Signage in itself ranges from individual signs to complete systems, but what makes a wayfinding design effective is that it is consistent, concise and clear, and takes into consideration the environment in which it is supporting (Huppatz, 2020). Additionally, the larger the system design project, the more stakeholders must be involved to ensure it is truly inclusive.

A pictogram is a visual image used to deliver information through a nonverbal communication method. Pictogram systems are a series of pictograms, unified in design,

applied to a specific place or environment. Pictogram systems as a form of signage are used to convey information that can be easily and instantaneously understood by a mass majority of users (Clara, S., & Swasty, W., 2017, p.166). There are many advantages to leveraging pictogram systems as a form of signage such as allowing immediate interpretation with greater accuracy to quickly communicate important messaging. Successful case studies demonstrate the effectiveness of pictograms as universal and international communication. An example of a pictogram system is road safety signs. Road safety signs allow drivers to receive important information about driving safety, dangerous conditions and navigation. These pictograms use different representation, colours and shapes for easy identification.

Figure 19

Road Safety Signs

Regulatory traffic signs. Multicolour Signs. (n.d.). https://multicolorsigns.com/regulatory-traffic-signs/.

What makes this pictogram system effective is that one can see these designs specifically in the environment they were made for, the road. The colour is reflective and contrasting to its environment making it noticeable. The consistency and simplicity of the design ensures that drivers will see them and know that the signs represent provincial driving laws. The stop sign itself is an interesting case study as the red hexagon is universally understood as the word “stop”. But in France, one can find that they also opt to use the English word “stop” rather than in French.

Though designing a single pictogram can be easy, designing a successful pictogram system is not an easy feat. The pictograms of a system need to inform the user of some sort of information and guide them, depending on the situation, all while being visible and clear to ensure accessibility (Adir et al., 2021). However, according to Arthur & Zlamalik (2005), it is important to keep in mind that “the topic… is the main thing that must be determined before designing pictograms” meaning that prior to even designing, what one is trying to communicate and to whom should be identified at the infancy of the design process. This can be facilitated by simplifying the message into a few words to provide a solid basis for the design process. After determining the main message that a designer wants to communicate, the next step is to think through the design. “Modern symbols are transcendent, transcultural, and transmedia… the strongest symbols being those that omit the non-essential.” (Reeves, 2021). Like the main message, the overall design must also be simple and only provide essential communication. As seen in the case studies above, less language and strong imagery bode for a powerful message. Signage needs to be succinct to ensure that users can decode the message quickly and easily. Another important element of signage would be to include some sort of direction to orient users. Whether it be an arrow or a direction such as north or south, this would support users with getting a better sense of where they need to go to reach their end point. When one is designing for a larger area, uniformity and consistency across all signage is crucial. This helps individuals build familiarity with information so that should they encounter it again, it will take

less time for them to try and understand what it means. When it comes to pictograms, simplification of design for any symbol allows the visual cue to become stronger in delivering its message. However, this does not mean that pictograms need to be used alone. Having an impactful pictogram paired with other forms of additional communication methods may allow the message to become clearer. When examining the TTC as a case study for pictogram systems, it seems likely that end user design and navigation needs may not have been fully taken into consideration.

Figure 20

TTC Signage at St. George Station

In figure 20, it is clear that the signage is repetitive and could create confusion for users who are unfamiliar with the system. Those who are unexperienced with the TTC would not know that there are currently three different ways to address what direction one is going: direction can be identified by the line name, colour and number. Though these are interchangeable, the fact that there are three to begin with goes against what Huppatz identifies as attributes of effective signage design: consistent, concise and clear. The lack of consistency as to how the lines are referred to can cause confusion amongst its users. Figure 20 shows how the sign also lacks

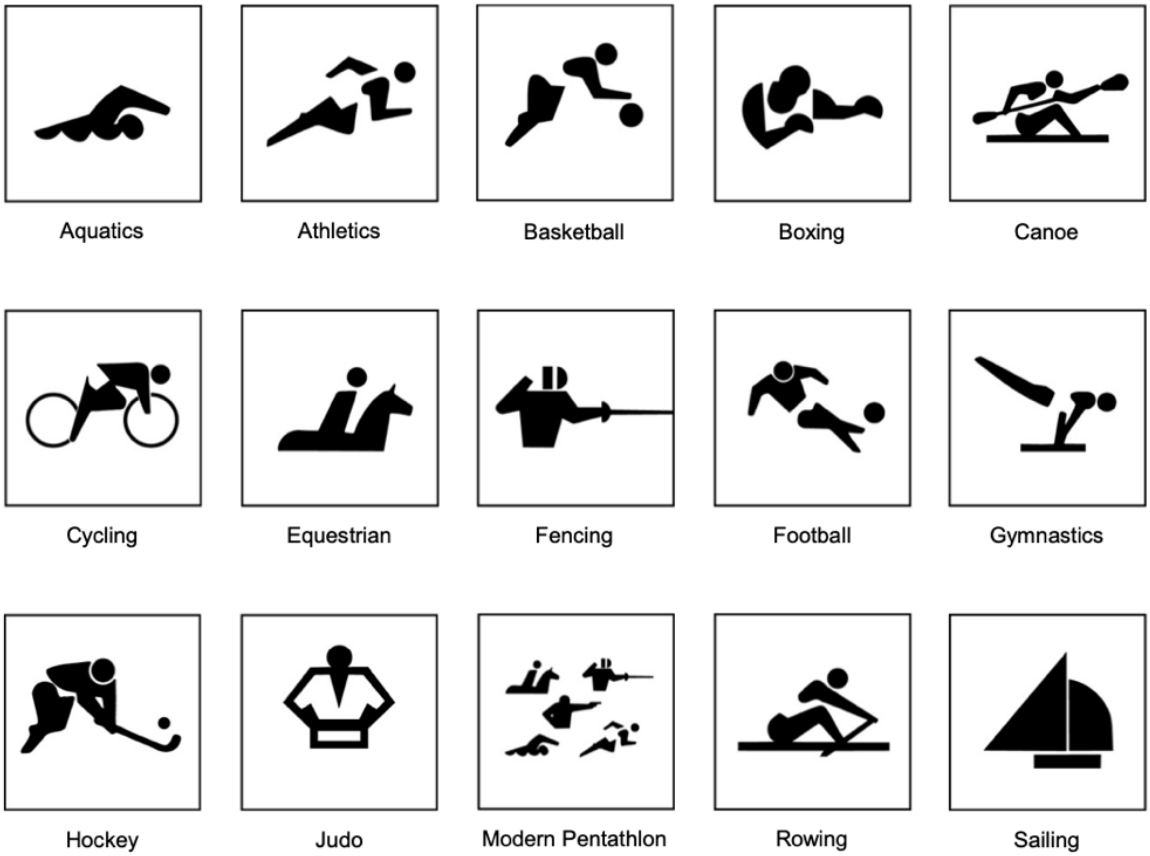
clear and concise communication as the same message is being repeated multiple times but referenced differently. From an international language and culture context, the only effective piece in this signage is the icon of train and bus; travellers will know that the subway is below, and that buses are above. Yet, these travellers will not know what direction these modes of transportation are going, leading to low situational literacy. In terms of design, this is poor execution. Recognizing that there may not be many areas for signage underground, this sign was placed closest to the train tracks allowing very little space for it to be seen from different angles. To make this signage more inclusive, signage should be larger, posted frequently in more accessible areas and should provide supplemental communication so that individuals have more information available through a variety of different methods. To provide further recommendations, on how to create inclusive navigational pictograms that address situational literacy gaps, one can examine an effective case study that garners high traffic international audiences.

Evaluating the Effectiveness and Inclusiveness of an International Case Study

The Olympic Games are an international event that happen every four years where people from across the world travel to the city hosting the festivities to cheer for countries. This event is a cultural melting pot that includes participants and spectators from over 100 officially recognized countries across the world.

Figure 21

1964 Tokyo Olympics



International Olympic Committee. (2017, February 9). *The Sports Pictograms of the Olympic Summer Games from Tokyo 1964 to Rio 2016*. The Olympic Studies Centre. https://stillmed.olympic.org/media/Document%20Library/OlympicOrg/Factsheets-Reference-Documents/Games/Pictograms/Reference-document-The-Sports-Pictograms-of-the-OG-from-Tokyo-1964-to-Rio-2016.pdf

The first modern use of pictograms for this event was in the 1964 Olympic Games, which were held in Tokyo: the capital city of Japan. Two graphic designers by the names of Yoshiro Yamashita and Masaru Katsumi, along with the organizing committee for the games, felt the need to develop a form of visual communication that would transcend language providing information to participants and spectators due to the ever-increasing number of nationalities at the event (International Olympic Committee, 2017). It was clear that situational literacy was low in previous games as visuals were predominantly used to illustrate the sport in a schematic way

and were featured mostly on official publications or on entry tickets (International Olympic Committee, 2017).

Figure 22

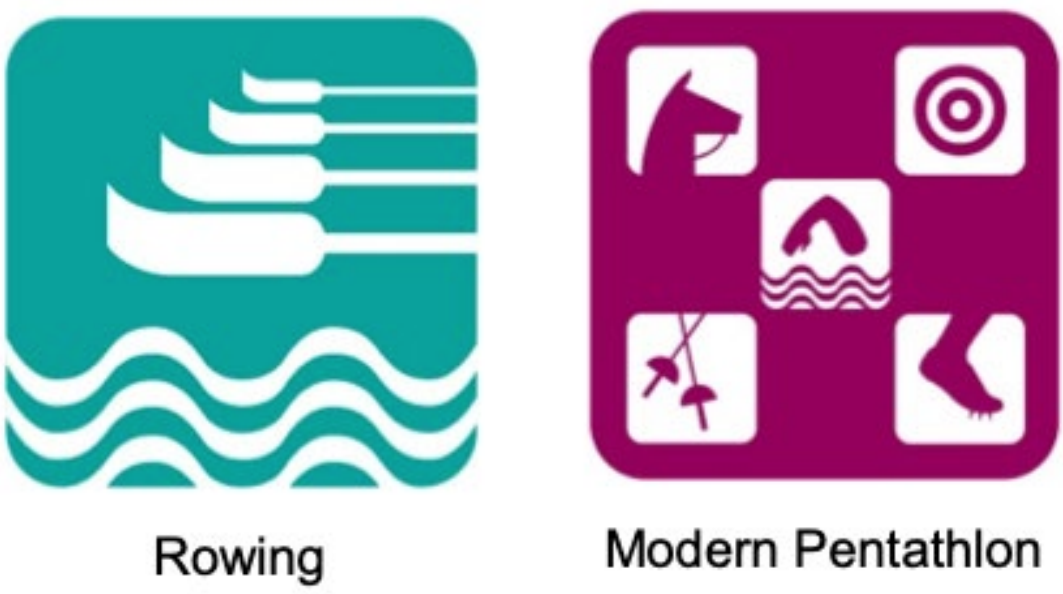
Ticket from the 1960 Olympic Games in Rome

Olympic games 1960 Rome. Olympic Games Museum. (n.d.). https://www.olympic-museum.de/ticket/olympic-games-tickets-1960.php.

The solution was to create a pictogram system that would visually communicate the sport through other modes of communication. The creation of this effective and informative pictogram system made it fundamental for futures games to have this feature as well. Though each Olympic Games developed its own new set of pictogram systems that were culturally influenced, the original intent and concept of those created in Tokyo remained the same.

Figure 23

Olympic Games Pictogram Systems – 1968 Olympics in Mexico



International Olympic Committee. (2017, February 9). *The Sports Pictograms of the Olympic Summer Games from Tokyo 1964 to Rio 2016*. The Olympic Studies Centre. https://stillmed.olympic.org/media/Document%20Library/OlympicOrg/Factsheets-Reference-Documents/Games/Pictograms/Reference-document-The-Sports-Pictograms-of-the-OG-from-Tokyo-1964-to-Rio-2016.pdf

Figure 24

Olympic Games Pictogram Systems – 1992 Olympics in Barcelona

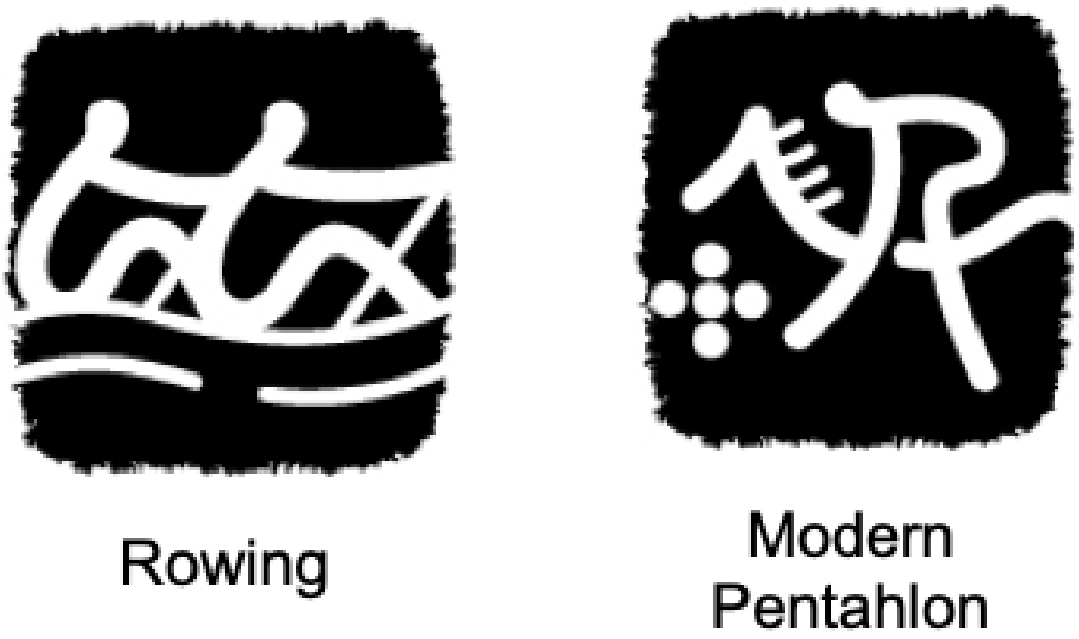
Rowing

Modern Pentathlon

International Olympic Committee. (2017, February 9). *The Sports Pictograms of the Olympic Summer Games from Tokyo 1964 to Rio 2016*. The Olympic Studies Centre. https://stillmed.olympic.org/media/Document%20Library/OlympicOrg/Factsheets-Reference-Documents/Games/Pictograms/Reference-document-The-Sports-Pictograms-of-the-OG-from-Tokyo-1964-to-Rio-2016.pdf

Figure 25

Olympic Games Pictogram Systems – 2008 Olympics in Beijing



International Olympic Committee. (2017, February 9). *The Sports Pictograms of the Olympic Summer Games from Tokyo 1964 to Rio 2016*. The Olympic Studies Centre. https://stillmed.olympic.org/media/Document%20Library/OlympicOrg/Factsheets-Reference-Documents/Games/Pictograms/Reference-document-The-Sports-Pictograms-of-the-OG-from-Tokyo-1964-to-Rio-2016.pdf

The reason why these pictogram systems created a precedent at the Olympics is because they were specifically intended to be recognizable by people from different cultures and backgrounds. In order for a pictogram to be recognizable, it must be a “representation of an object from the real world, a fantasy motive, an action, a sound, a gesture, a state or even a feeling. It can be as simple as a basic shape, or as complex as a realistic 3D object” (Vidovic, 2016). Users are able to decode the pictograms without the assistance of text because familiarity is what makes the pictogram system functional.

Though these pictogram systems started off by being iconic in nature, as seen in figure 21, the progression and evolution of the pictogram systems in figures 23, 24 and 25 show how

heavily culture and artistic style contributed to the design of these pictograms. Differentiating sports should be a relatively simple case, but when looking at the pictogram system developed for Mexico in 1968, (see figure 23), while they were the most colourful pictograms in the Olympics yet, they perhaps traded accessibility for aesthetics. In these designs, visual accessibility seems to be questionable as some of these designs are bright with white design work, which is hard for those with low vision to see. User testing and perceptual analysis was clearly not done or taken into account. For example, when examining the pictogram for rowing, the cyan background in contrast with the white is not accessible to those with low vision because the lower the contrast, the harder it is to read. Though the choice of colours is problematic in some cases, the visual form itself in the pictogram appears effective in comparison to the pictogram systems from Barcelona in 1992 and Beijing from 2008. These pictograms may be hard to decipher because of the stylistic choice of the designer. In figure 24, the pictogram intended to represent rowing suggests two statues fishing. What were meant to be icons became symbols. Again, in figure 24, the pictogram for modern pentathlon went from one abstract image of what can look like a person riding a horse to figure 25, where the horse looks like an entirely different animal.

If the dominant culture may have difficulty with understanding the meaning behind the pictograms, they will be equally if not more difficult for those with lower situational literacy to use. The only positive element about figures 24 and 25 are that the colour choice, black and white, are accessible. If the simple design from Mexico were paired with the colours chosen for Barcelona and or Beijing, the pictogram system might have better served a larger audience. For future games, it would be interesting to see if the systems continue towards a symbolic trajectory or if they revert to iconic. Nonetheless, it would be useful to do user testing and co-design work to ensure improvement in situational literacy prior to the launch to guarantee effectiveness. Moving forward, consistency and uniformity in the design of these pictogram systems should be taken into consideration, regardless of which country the games are held.

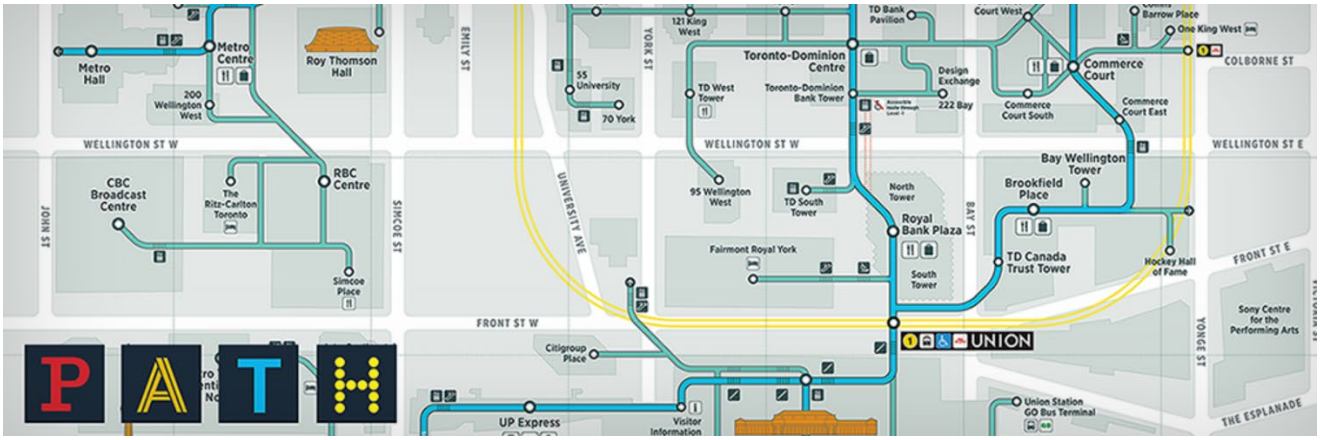
Similarly, as examined previously in figures 8, 9 and 10, the same airport signage across three different international airports depicting the concept of connecting flight or transfer were all shown in different ways. Though the lack of uniformity in the design is a downfall of this specific representation, culture may have played a part in how the pictogram was designed. This confusing pictogram is unlikely to increase any new traveller's situational literacy. As mentioned before, situational literacy will increase as an individual continues to habituate themselves to different international airports and relatedly, the word transfer in itself may become an icon. To better support international travellers going to new places, like the Olympic Game pictograms, uniformity and consistency in design should be employed.

Further Exploring the Effectiveness and Inclusiveness of International Modes of Transportation

The PATH is an underground walkway utilized by pedestrians. Its walkways connect to Toronto's public transportation systems, such as the subway, and other aspects of the city including restaurants, shopping centres and other services. Being a complex navigational system, it is only effective for those who are Torontonians and familiar with the city.

Figure 26

Map of the PATH – Union Station



City of Toronto. (2021, March 12). *PATH – Toronto's Downtown pedestrian walkway*. City of Toronto. https://www.toronto.ca/explore-enjoy/visitor-services/path-torontos-downtown-pedestrian-walkway/.

The map in figure 26 shows users how to navigate the PATH north of Union Station. Immediately, it is clear to see that there is no legend or colour coding associated with the lines of the path, which are blue and green.

Figure 27

Map of the PATH – St. Andrew Station

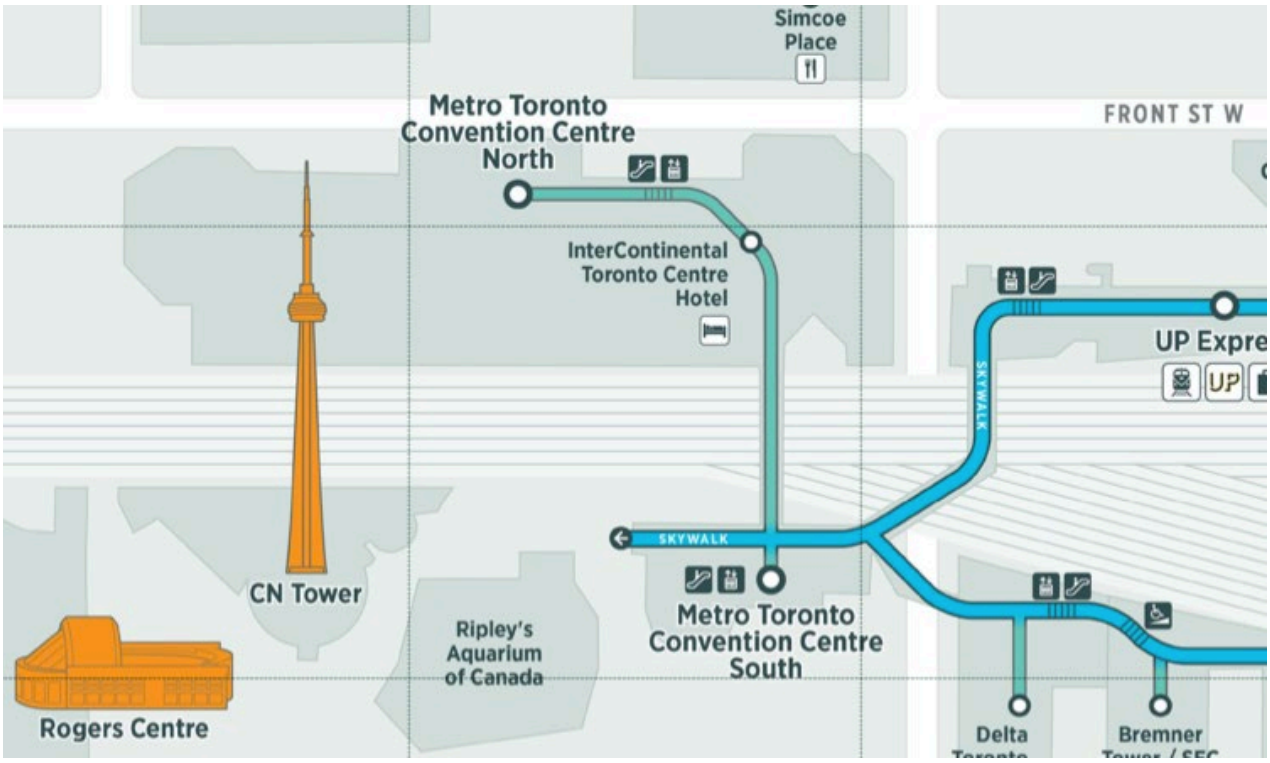
Toronto PATH Network. City of Toronto. (n.d.). https://www.toronto.ca/wp-content/uploads/2018/03/8d6c-path-network-map.pdf.

The other aspect of this map that may be confusing to users is that, rather than utilizing the names or intersections of streets, key identifiers for navigation are building names. For example,

if one were trying to get to the intersection of King Street West and York Street, rather than looking for the name of the intersection as an indicator, PATH users would instead look for the Exchange Tower. Lastly, the map of the PATH contains some pictograms, such as restaurant, escalator and retail stores, however it does not include any iconic pictograms for the actual destination areas, aside from some subway stations. It also does not offer any other form of communication vehicles for non-English speakers, making this system harder to navigate. To make this more accessible for users, the PATH should implement more pictograms that represent the physical landmarks above, such as the one below in figure 28.

Figure 28

Map of the PATH – West of Union Station



Toronto PATH Network. City of Toronto. (n.d.). https://www.toronto.ca/wp-content/uploads/2018/03/8d6c-path-network-map.pdf.

Mexico City is one of the largest cities in the world, with around 4.4 million people riding the city's Metro system every day. The Metro system is one of the easiest rail systems to navigate, partly because of its iconography, which was created by Lance Wyman – the same individual who created Mexico's 1968 Olympic Games pictogram system (99pi, 2017). Like the pictograms created for the games, each station in the Metro system had an identifiable icon, based on current and ancient architectural associations in conjunction with the built environment (99pi, 2017). The podcast host on *99% Invisible* states that Wyman's justification for this revamp was inspired by the games since users relied heavily on the pictograms to receive information. The affordances of navigational visuals could be transferrable to other forms of non-linguistic communication, such as public transportation (2017). In figure 29, shown below, one can see how Wayne was inspired by historical or structural landmarks. For example, Chapultepec Park is a specific station in Mexico City where Wayne based his icon design on a physical landmark associated with the grasshopper. "Chapultepec means grasshopper hill in the Nahuatl Aztec language" so he used the image of a grasshopper as the basis of the station's pictogram (99pi, 2017). The uniqueness of every pictogram in this specific system allows a wide variety of users to use it regardless of language, nationality or any other factors.

Figure 29

Chapultepac Park – Mexico City's Metro Station

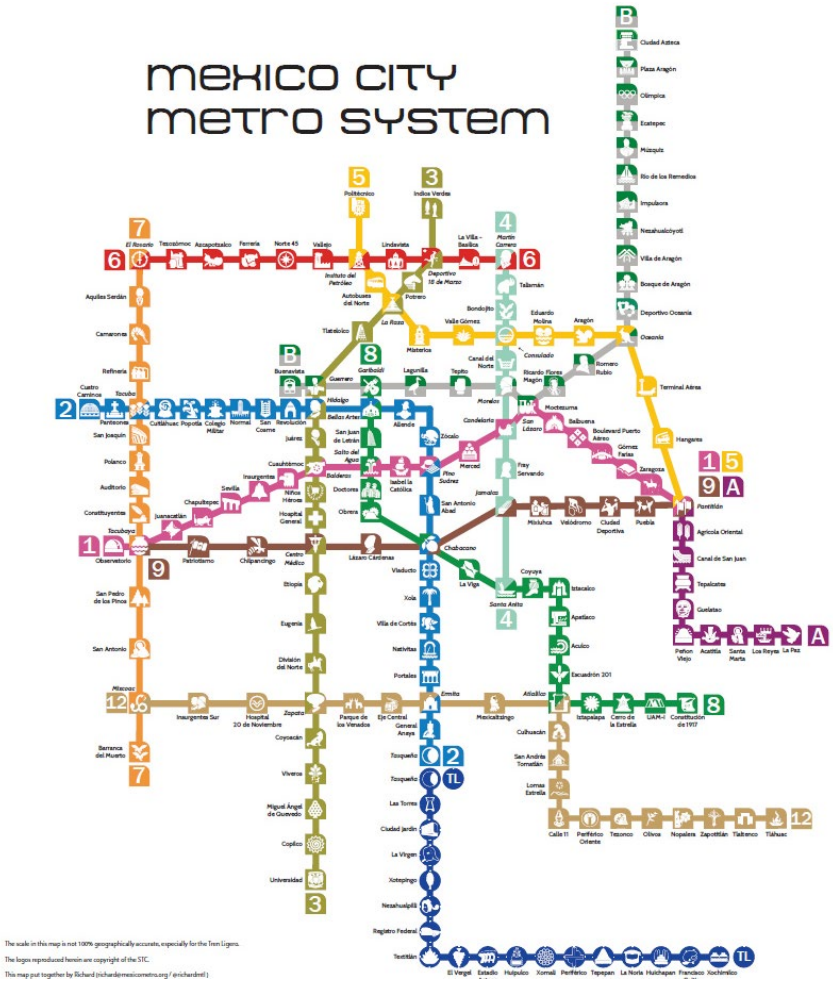
99pi. (2017, June 26). *Mexico 68*. 99% Invisible. https://99percentinvisible.org/episode/mexico-68/.

Though this pictogram system used in the Metro caters to a wide variety of different users, it is important to note that, once again, culture heavily influences the final design of this system. As mentioned, every station is represented by an identifiable icon based on elements of the built environment, meaning that those who know the city would be able to decipher what those stations mean in correlation to the built environment. For anyone who does not speak the local language nor is familiar with Mexico itself and its culture will once again experience low situational literacy because they will not know what the representation within the pictogram means. An additional problem is that the icons impact visual accessibility when employed in a

map. As seen below in figure 30, the use of low contrast colours makes the map relatively inaccessible for those with vision impairment. Recommendations on how to make Mexico City's Metro system more effective and inclusive would be to conduct stakeholder engagement sessions with those who identify as visually impaired to better determine what colours do and do not work for their needs.

Figure 30

Mexico City's Metro System



99pi. (2017, June 26). *Mexico 68*. 99% Invisible. https://99percentinvisible.org/episode/mexico-68/.

General Principles of Inclusive Design

Inclusive design is the idea that all design, from its initial conception to the end product or service, analyses and addresses the needs for all, as much as possible. This form of design recognizes that no two humans are the same and that design in itself must be flexible and customizable to be inclusive. By casting a wider net for potential stakeholders, it allows for the design to adapt to the needs of its end users through research and co-design. When creating design using this methodology, one needs to approach it with an all-encompassing mindset. Swan et al. in their publishing on *Inclusive Design Principles* condense it down to seven different elements: provide comparable experiences, consider situations, be consistent, give control, offer choices, prioritise content, and add value. Though these are good considerations to take into account when creating inclusive designs, they lack a fundamental element, user feedback. Utilizing Swan et al.'s design principles as a starting point, one can address all elements of inclusive design by breaking it down into three themes: analyzing user needs, establishing guiding design principles, and acknowledging creator bias.

When analyzing user needs, the first thing to be mindful of is whether a designer is providing the same experience to all users who may interact with the design. This can be achieved by communicating the content in multiple ways. In the context of navigational design, this can be done by providing linguistic (written text) and non-linguistic (visual) communication. Making the experience customizable as well is important. This can be done by providing end users a variety of different ways to interact with the design so they can choose what best suits their needs. The affordances of modern technology allow for a much greater range of ways for users to engage with information. Another question to ask is if the design caters to the needs of people in different situations. By acknowledging that everyone has a unique set of intersectionality's such as gender, culture and disability, one can start to see the larger scope of individuals who can benefit from this design. It is important to recognize that there will be a variety of different types of interaction with the design; ranging from those using it for the first

time and those who are highly familiar with it. For navigational design, simple solutions such as high contrast, simple language or captions can help mitigate this problem and bridge the gap of potential situational literacy.

By establishing guiding principles, designers can address consistency, simplicity, and value add of the design. Maintaining consistency in the designs itself is important as familiarity and understanding help individuals recognize the design, thus making it intuitive. Using the same font, colours, universal pictograms and size help build that familiarity. Simplicity allows designers to ensure that the design output is refined so that it is straightforward and allows the user to understand the main message quickly. This goes back to the idea that not all users engaging with the design are familiar with the environment, so keeping the message simple supports their needs. Wherever possible, it is also important to add alternate means of access. Whether that be with the integration of QR codes, screen readers, or other forms of multimedia, by adding different layers of communication, one is adding more information to the design.

Lastly, every designer must acknowledge their own biases. Humans have their own unconscious biases, which are developed through their own lived experiences. Recognizing this while designing is important as it allows the creator to open their minds to different end results. To combat personal bias, creators must understand that co-designing is part of inclusive design. A designer who is creating a product for blind people cannot speak for the lived experience of the blind, therefore need to work with someone who is blind to ensure the product works for them. For a design to become more inclusive, it has to go through rounds of multiple trial and error through co-designing, and an iterative process of test and measure.

With the demographic of Canada constantly evolving and diversifying, the need for inclusive design is more relevant than ever. According to the *2020 Annual Report to Parliament on Immigration*, in 2019 alone 341,180 permanent residents were admitted in Canada with permanent and non-permanent immigration accounting for 80% of Canada's population growth (2019). On the other hand, by 2030 the aging demographic, which according to the *Government*

of Canada's Action for Seniors Report, will be over 9.5 million in Canada, making up 23% of the country's population (2014). Canada will soon need to adapt information to different user needs. By leveraging inclusive design, Canada can start to pave the path for an equal and accessible future for all Canadians.

Inclusive Design in the Context of Navigational Design

People may successfully navigate using forms of pictogram systems, but it is important to continue to design better systems. There are several factors to take into account when creating inclusive signage based on the case studies presented above. The first one being: what is the communication users need to decipher? Is the pictogram meant to serve as a call to action, a reminder, a form of direction? These questions need to be addressed prior to creating any system. Rogers (1989) states that the following key elements should be taken into consideration when creating interfaces: universality, compactness, recognition and comprehensibility. Universality allows the transcendence of language. Pictograms, such as the wheelchair accessibility and modes of transportation (see figure 31) can be identified by anyone regardless of their situational literacy; it is important to have these pictograms in the system. Compactness refers to how the simple design elements of a pictogram allow for them to become as meaningful as the word itself. Going back to figure 31, those taking any mode of public transit and require accessibility support know to follow the wheelchair image. Rather than the sign saying "go right to use the elevators" it is condensed to a series of pictograms: the wheelchair and a directional arrow pointing right with the word *elevator* as accompanying text. One can argue even further and say that the word elevator would be part of the pictogram as non-English speakers would see it as an identifier rather than a word, which leads to recognition. Recognition allows users to decode the message faster. Lastly, comprehensibility references as to how clear the message is.

Figure 31

TTC Signage at St. George Station

Also needing consideration is the actual design elements for the pictogram such as colour, font, size and mode of communication. If this is meant to be inclusive signage for public transportation, the colour of the background needs to contrast with its environment, to make it recognizable, the font and size would need to legible from a distance, the colour of elements on the sign must contrast with the colour of the background, and lastly the signage should be on walls or ceiling signage above eye level so users recognize it as navigational signage, and it can be seen when there are other people between the user and the sign.

The physical environment which it is being designed for must be taken into consideration as well. Modes of transportation are used by many different users: locals and travellers. Sight lines may be long or short, and users may come at them from different directions. So, study of transportation flows and on-site observation is necessary.

To ensure situational literacy is addressed, not only does the pictogram have to be compact, but, given the affordances of modern technology, there is an opportunity to provide the low situationally literate traveller with additional information, or with text in other languages; for

example, in the form of a QR code that can provide access to further or alternate information via an electronic device.

Finally, when designing for an environment that is encountered by all different types of users, it is important to note that there will always be elements of cultural or thematic specific nuances. Like the example above in figure 31, the theme would be public transportation specific to the TTC and specific to St. George subway station. This means that there will always be elements of the pictogram system for the TTC that cannot be transferrable to another transportation system, such as Mexico City's metro. This is the cultural element that cannot be replaced but rather can be supplemented with additional modes of communication vehicles to fill in the gaps of knowledge for users, therefore increasing their situational literacy.

Elements of Inclusive Navigational Signage

By combining general principles of inclusive design in the context of navigational signage, one can reference the list below to design successful inclusive signage utilizing a universal pictogram system.

Analyzing user needs:

- What is the environment the navigational signage is being created for?
- What is the main message of the signage?
- How is the signage ensuring all users have the same experience? If it is not doing that, what are the gaps and how should they be addressed?
- Is the signage experience customizable?
- Does the signage cater to the needs of people in different situations?

Establishing guiding design principles:

- Does the design of the signage maintain elements of consistency through font, colours, universal pictograms and size?
- How simple is the signage?

- Does the signage add value?

Acknowledging creator bias:

- Are there any cultural or thematic nuances?
- What are the bias gaps in the signage design?
- How can this be co-designed and what stakeholders need to be a part of that process?

Creating Inclusive Navigational Signage

For the purpose of this exercise, a digital revamp of the TTC's subway signage was done in an attempt to use the list above to create examples of inclusive navigational signage using pictogram systems to address low situational literacy. The same method was then applied onto signage in the PATH, a system of underground pathways in downtown Toronto.

When analyzing user needs for the TTC, one needs to first address what the environment the navigational signage is being designed for. Figure 32 below is the current signage located in St. George Station; one of the TTC's busiest subway stations.

Figure 32

Current Signage at St. George Station

There are six main messages the current sign is trying to communicate. However, these can be reduced to three: the exit is upstairs on the right side, which can also lead you to the University of Toronto's campus, the subway trains going eastbound/westbound are downstairs, and the buses are upstairs. Currently this signage is likely to be sufficient for those who know the TTC system and read English. The pictograms used are iconic, so those with low situational literacy will know where to go to take different modes of transportation, however, in which direction they go is unclear. Further information is needed to bridge any situational literacy gaps. There is another potential gap, which is the needs of people with low to no vision. There is no braille or screen reader technology that is allowing that group of stakeholders to interact with the design. As it sits, the experience is not customizable. There are only two ways of receiving and decoding the information: through the pictograms or the text. Further information through different communication vehicles could add value to the signage.

When establishing guiding design principles, there are many things to take into account. Signage maybe governmentally regulated. In the province of Ontario, signage must follow the AODA (Accessibility for Ontarians with Disabilities Act). Other basic inclusive design principles

should also be applied. According to the *Access Ability Handbook,* written by the Association of Registered Graphic Designers of Ontario with support from the Government of Ontario, there are many principles to take into consideration when creating signage.

Figure 33

Example of 70% Light Reflectance Value (LRV) Contrast

The Association of Registered Graphic Designers of Ontario (RGD Ontario). (2010). *Access Ability: A Practical Handbook on Accessible Graphic Design*. RGD. Retrieved September 10, 2021, from https://www.rgd.ca/database/files/library/RGD_AccessAbility_Handbook.pdf.

Signage should have a finish that is matte or non-glare to warrant readability from different angles and “as a general readability standard, a minimum of 70% contrast ratio of the

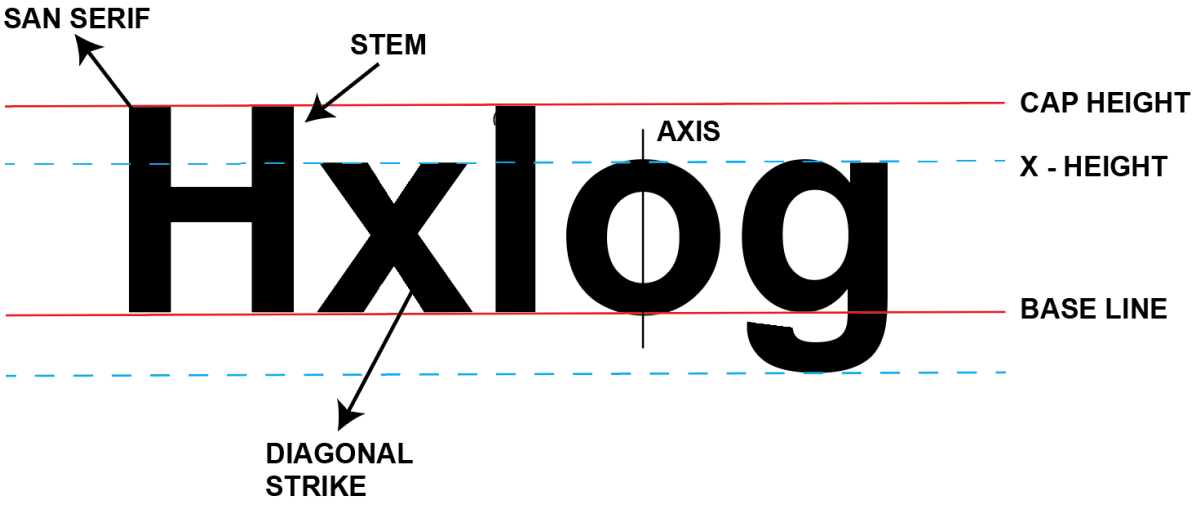
foreground to background is recommended for all signage", which can be seen in figure 33 (2010).

With respect to font, the *Access Ability Handbook* (2010) states that there are many specifications to ensure it is legible such as:

- the type should be sans serif;
- a mix of uppercase and lowercase lettering;
- optimal width and stroke ratio;
    - the width of an uppercase letter "O" must be between 55% - 120% of the height of an uppercase "I". The stroke may only be 15% of the height of an uppercase "I".
- character spacing of no less than 3mm and no greater than four times the stroke width; and
- fall in line with relationship between type size and viewing distance, which is a 25mm cap height for every 7.5m of distance.

Figure 34

Arial Bold Font Analysis

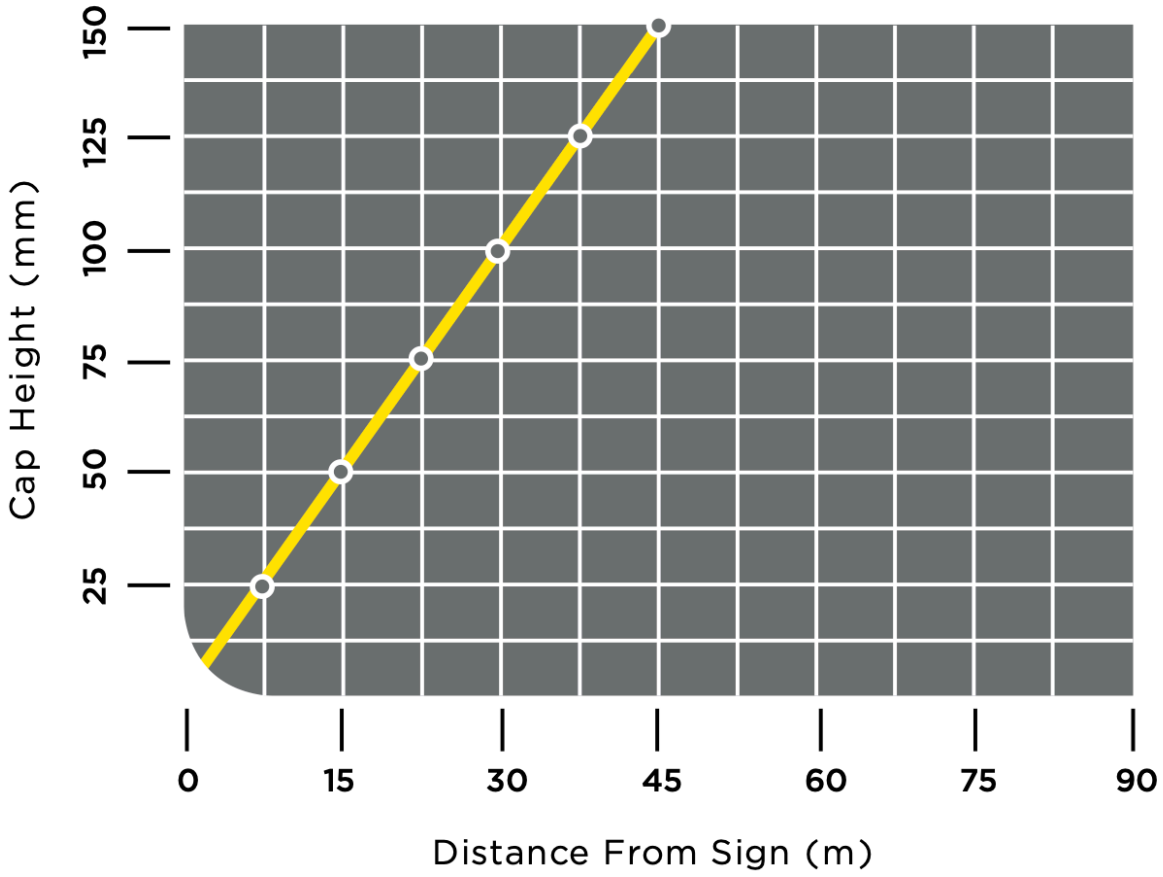


There are many fonts that are ADA (Americans with Disabilities Act) compliant and meet the criteria above. One of these is Arial. Arial is a san serif font, with conventional width and good balance of stroke and counter in both its regular and bold weights (see figure 34). It works well for signage and is a font that is generally recognizable across the world due to its integration into online writing documents, such as Microsoft Word. Arial was the font chosen for this research paper as well.

Wall-mounted directional signage is not required to have braille or any tactile elements but according to the *Access Ability Handbook* (2010), it is important to ensure "the recommended standards for text size [, which can be seen in figure 35] and contrast ratio [, which can be seen in figure 33] are being followed". As one can see below, the further the sign is from the user, the larger the font size (entire height of the font) needs to be. The ratio of a 25mm cap height for every 7.5m of distance helps to achieve the design of an accessible sign. However, the height of capitals is not necessarily a good indication of the apparent size of lowercase letters. Consequently, the cap heights, shown below in figure 35, only work for fonts that have an x-height of around 70 percent of the cap height.

Figure 35

Text Size to Distance from Sign Ratio



The Association of Registered Graphic Designers of Ontario (RGD Ontario). (2010). *Access Ability: A Practical Handbook on Accessible Graphic Design*. RGD. Retrieved September 10, 2021, from https://www.rgd.ca/database/files/library/RGD_AccessAbility_Handbook.pdf.

In terms of mounting height, normally the ideal height would be to place the centre line at 1.5m and it is important that consistent placement is used to meet the expectations of those with vision impairment. The bottom of the sign should be high enough to avoid it being obscured by the presence of people between the viewer and the sign.

Referring to figure 32, when applying the general design principles, the sign does maintain consistency in font, colours and universal pictograms, but size of signage in the TTC is

a significant issue. When looking at Appendix B, one can see how the signage size and location change providing little consistency. Some signs are simple, and some are more complex and may be overwhelming. Take figure 32 as an example. The arrow pointing down for trains is one message, then there is another with the same arrow pointing down showing the number “2” and the text “eastbound/westbound”. Though this is the same information, it makes it appear as if there are an additional two levels below when there is in fact only one. It is clear that the sign on the right was added later than the sign on the left, which suggests poor planning of design and wayfinding. How the sign is communicating is different as well. As seen in Appendix B, in some cases the design of the northbound/southbound signs are just text and directional arrows while for other stations, they have text, directional arrow, pictograms and stylistic changes. The signage can do a better job of adding value as well. As it stands, it only provides information through pictograms and text. Other options, such as QR codes and station specific pictograms representing the build environment above, should be explored to provide users with more information thus bridging any potential situational literacy gaps.

When applying the opportunities of consistency in sign messaging and size, simplicity, and adding value through additional pictograms and QR codes, one can see how the current TTC signage (see Appendix B) has areas for improvement, which can be seen in design mock-ups below.

Figure 36

Revamped TTC Signage at St. George Station

Figure 37

Revamped TTC Signage at Queens Park Station

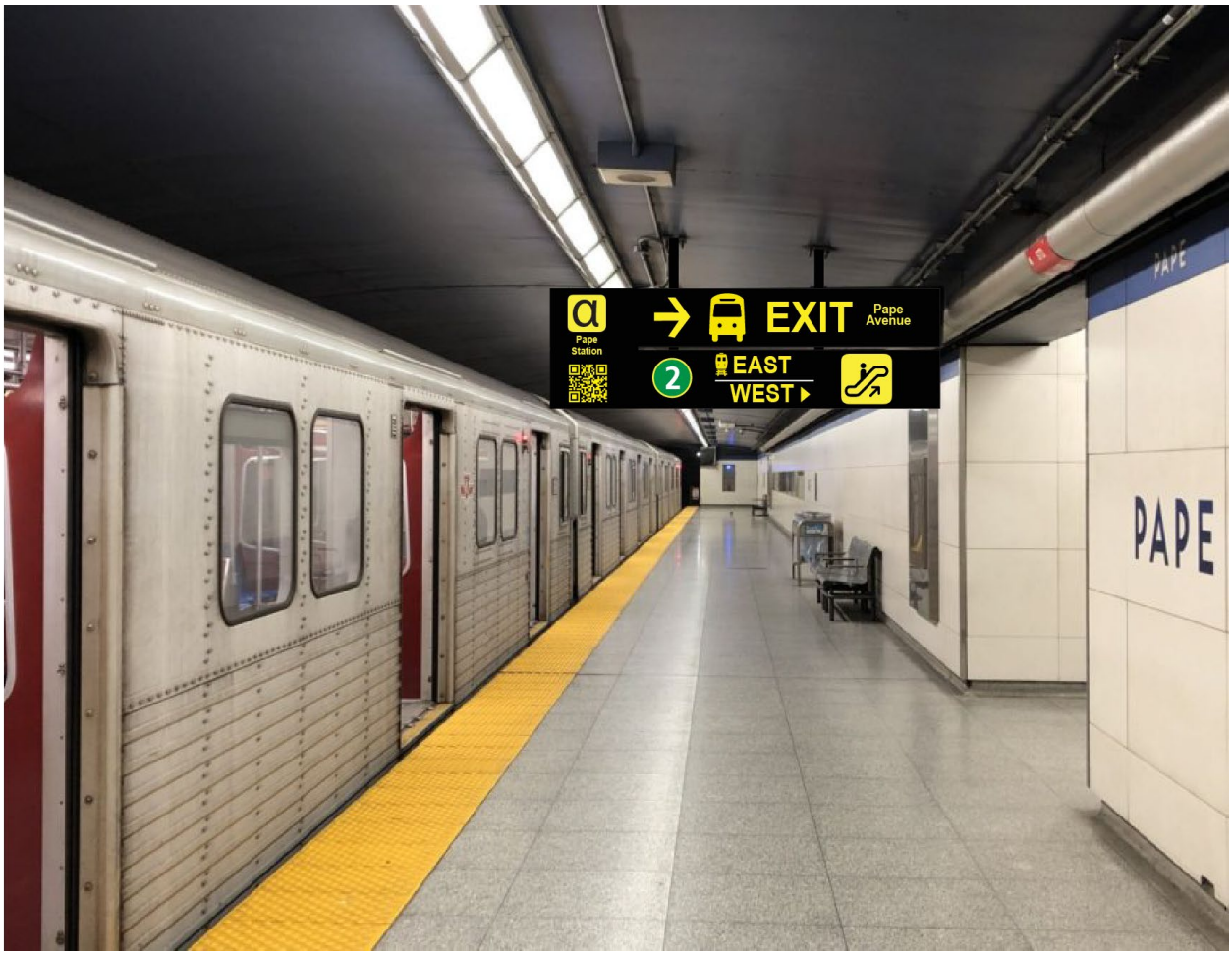
Figures 36 and 37 show two potential new signs that can be used in the TTC. Figure 36 uses St. George Station to show what revamped signage could look like. The three main pieces of navigation communication (exit, train and bus) were simplified to one word per pictogram. This will make it easier for those with low literacy and low situational literacy to better grasp the directional communication along with addressing the needs of travellers in a hurry. The two new elements in both signages are the station pictograms and QR codes.

The station pictograms drew inspiration from Mexico City's Metro stations where each station has its own unique pictogram. The representation of the visual from the pictogram can be of the built environment above or derive from cultural representation. In figure 36, one can see the station pictogram selected is of a graduation cap. This bears significance to the University of Toronto, which St. George Station is close to in proximity. Another built environment reference is Queens Park Station (figure 37). This station pictogram is of a cross

representing hospital as this station is closest to Toronto General and Mount Sinai Hospital. One might argue that these would have to be learned experience as individuals with low situational literacy may not know what these pictograms mean. On the contrary, as most of these pictograms represent the built environment, this will be beneficial to tourists who are wanting to explore the city. When the built environment cannot be represented through station pictograms, cultural representation can be employed.

Figure 38

Revamped TTC Signage for Pape Station



Van Hoepen, C. (2019, April 22). *Developing: Premier Doug Ford announces $28.5 billion in funding for GTA transit*. The Toronto Observer. Retrieved September 11, 2021, from

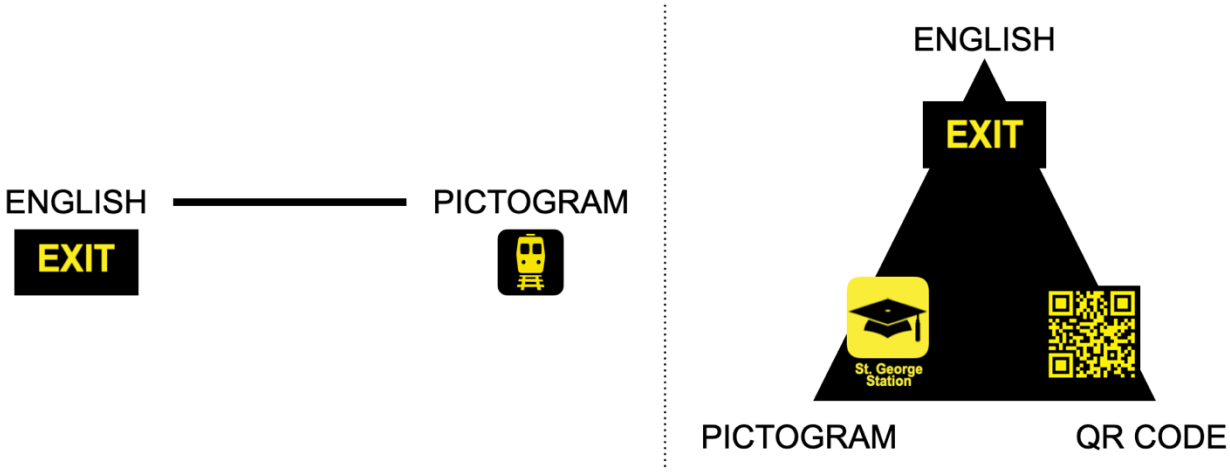
https://www.google.com/search?q=pape%2Bstation&client=safari&rls=en&sxsrf=AOaemvLr4oL7w3mKzXd12f45fUe4ERh-wg%3A1631337867300&source=lnms&tbm=isch&sa=X&ved=2ahUKEwif2tqQl_byAhVDZN8KHcd-CVcQ_AUoA3oECAEQBQ&biw=1440&bih=820#imgrc=HXp4B6wYG9nTvM.

In the example above in figure 38, one can see how cultural representation was utilized as the station pictogram for Pape Station. Pape Station, like many other stations in the TTC, is a stop that is further out from the downtown Toronto core. Some of these stations do not have any iconic built environment visuals to turn into a pictogram however, they are rich in culture. Pape Station, along with a few others on Danforth Road are in the heart of Greektown in Toronto. Like many other culturally diverse neighbourhoods, Greektown is known for its vibrant atmosphere almost resembling a mini-Greece. Because of its rich and diverse culture, Pape Station's pictogram is of the lowercase letter "a" from the Greek alphabet. Although the concept is abstract, it has an indexical relationship with the location.

The addition of the QR code is something that is unique. Recognizing that users prefer to have several modes of communication so that they can adapt and choose to engage with the information in whatever way is easiest for them, the QR code is meant to add another layer of data. Traditionally, TTC signage is very linear in terms of its communication vehicles and their affordances, as seen in figure 39 below. If someone were to not know English, Toronto, or struggled to understand the pictograms, their situational literacy would be extremely low as there is no other way for them to attain information. With the addition of the QR code, the affordances of communicating different types of information through personal electronic devices is employed.

Figure 39

Old Signage Communication Vehicles vs. New Proposed Communication Vehicles



Modern technology, such as cellphones, offer affordances for navigation purposes, such as access to maps and directions. In this application, the cellphone can scan the QR code on the signage to provide users with more information. A QR code is a graphical item, but in this new form it acts as a mediated pictogram communicating navigational information to end users. As the TTC has wireless access in its stations, this provides the opportunity to provide enhanced navigation to both those individuals with low literacy as well as other users.

Figure 40

The QR Code Landing Page


ENGLISH
FRANÇAIS
ITALIANO
中国人
ودرا

Once a user scans the QR code, it will lead them to the page above shown in figure 40. The landing page is branded with the TTC map and logo but what makes it inclusive is that users get to choose what language they would like to receive the information. Once the user selects a language, they are then prompted to a new page that provides them with several different options, such as a map of the subway, a map of the buses and streetcars, but most importantly, it allows users to see where they are in Google Maps or Maps. This provides an opportunity to those with low literacy and low situational literacy to better orient themselves underground as it will show them the built environment above. Well-designed pages would also offer the possibility of using screen-reading technology to assist those with limitations of vision.

Though this pictograph and signage system appears to be successful for the TTC subway, it is important to see how this methodology can be mapped onto other modes of transportation to see if it has the ability to transcend navigational signages. The design mock-up below for the PATH addresses this question.

Figure 41

Revamped PATH Signage for the TD Centre

Note: please see Appendix C to see examples of current PATH signage.

Mapping the same design principles from the TTC subway signage to the PATH was straightforward. Again, some of the main affordances of this design in the environment of the PATH are that users know where they are going, and they have more information if they need it but the sign itself is simplified. In the PATH, it is hard to tell when and if an individual has entered a new building and which one it is. Yes, the physical environment may change, such as the walls or floors, but asides from that, it is very hard to locate oneself. The signs don't offer much value unless an individual knows the streets and buildings of downtown Toronto. By having a unique pictogram for each building, one will be able to construct a better idea of their location. The TD Centre's pictogram is composed of the letters "TD" but instead of the "T" being an alphabetic letter, the stem of the letter is a building, signifying that it is the TD tower/building. The other pictogram one can see on the sign is of the First Canadian Place building. Instead of using the same idea of a tower, one can see a literal representation of the name; a maple leaf with the number "1". Though people may argue that the maple leaf is rooted in Canadian culture, it is also part of the Canadian flag so is likely to be widely recognized. The TD centre pictogram is iconic in nature while the First Canadian Place pictogram is symbolic and indexical. The simplicity of the sign combats information overload, but should a user want more information, the QR code is there to provide it. By simplifying the signage and adding value through QR codes, inclusive design principles can be mapped onto other transportation navigation systems to support individuals with low situational literacy.

Discussion

Though mapping the inclusive design principles onto the TTC and PATH signage system seems to offer improved navigation, the element that is difficult to remove is culture. Culture plays a huge role and influences design. Going back to Mexico City's Metro, the entire pictogram system is rooted in culture. An example of this in the design mock-ups above was

how the signage must read (left to right), and how some pictograms such as Pape Station and the First Canadian Place must be learned through experience.

Another aspect that is hard to support without user testing is vision accessibility. Blind users have a completely different way of navigating spaces. Though the QR codes can be integrated with screen reading technology, the blind individual will first need to know that they must scan the sign. This ties into the last theme of elements of inclusive design: acknowledging creator bias.

As mentioned above there are cultural elements to the signage but there are also thematic nuances. These design principles are meant to be for navigational signage specific to public transportation. These may not work on other forms of signages, such as highway signs, which have different requirements in a different context. There are also bias gaps in the signage design. As mentioned above, this does not serve those who are completely visually impaired. Though elements of it does, to garner the attention of a blind person and ensure they scan the sign to gain additional information might be difficult without other forms of technology at play, such as beacon technology. Another potential gap is those who are not technologically savvy. The QR code, though not recent, is still a piece of technology that not all people will know how to use properly.

Lastly, prior to testing the signage in the built environment, extensive co-designing must be conducted to ensure user needs are addressed. The initial co-design session could be to gather different stakeholders to hear about pain points in the current system. These stakeholders could be TTC personnel, individuals with low situational literacy, varying literacy levels, varying visual impairments and varying physical abilities. One could then ask them to list out possible ways to make it more accessible. After that, the facilitator should show the proposed design solution to hear from users on what works, what doesn't work and see if there is any cut curb effects of the design. To recreate the signage in figures 36, 37, 38 and 41, one can refer to the Appendix D, *Inclusive Design Signage Manual* to ensure consistency of the

design. After implementing the changes requested from the co-design group, one will then need to show the same group the new design for their feedback. This iterative process should continue until all pain points have been addressed. Only then should testing in the built environment be conducted.

Future studies in this area should complete the recommended actions above and try to map the potential revised design onto other modes of public transportation at a national and international level.

References

99pi. (2017, June 26). *Mexico 68*. 99% Invisible. https://99percentinvisible.org/episode/mexico-68/.

Adir, G., Adir, V., & Pascu, N.-E. (2021). Pictogram, Powerful Information Tool for People. *Tehnicki Vjesnik - Technical Gazette*, *28*(4), 1433+. https://link.gale.com/apps/doc/A671555694/AONE?u=toro37158&sid=bookmark AONE&xid=e145ecc3

Airport wayfinding and graphics. SEGD. (2013, December 13). https://segd.org/airport-wayfinding-and-graphics.

Arthur, P., & Zlamalik, B. (2005). *Pictografic Systems*. Singapore: Page One.

Bradley, S. (2016, April 5). *Icon, index, and symbol - three categories of signs*. Vanseo Design. http://vanseodesign.com/web-design/icon-index-symbol/.

Clara, S., & Swasty, W. (2017). PICTOGRAM on signage as an effective communication. *Jurnal Sosioteknologi*, *16*(2), 166–175. https://doi.org/10.5614/sostek.itbj.2017.16.2.2

Designworkplan. (n.d.). Airport signage. designworkplan. https://www.designworkplan.com/read/airport-signage-photo-inspiration.

Epstein, R. A., Patai, E. Z., Julian, J. B., & Spiers, H. J. (2017). The cognitive map in humans: Spatial navigation and beyond. *Nature Neuroscience*, *20*(11), 1504–1513. https://doi.org/10.1038/nn.4656

Frutiger® font FAMILY Typeface Story. Fonts.com. (n.d.). https://www.fonts.com/font/linotype/frutiger/story.

Grannan, C. (n.d.). What's the difference between emoji and emoticons? Encyclopædia Britannica. https://www.britannica.com/story/whats-the-difference-between-emoji-and-emoticons.

Government of Canada. (2014). *Government of Canada — Action for Seniors report*. Canada.ca. https://www.canada.ca/en/employment-social-development/programs/seniors-action-report.html.

Government of Canada. Canada.ca. (2017, October 2). https://www.canada.ca/en/canadian-heritage/services/art-monuments/public-art/inukshuk.html.

Government of Canada. (2019, December 31). *2020 Annual Report to Parliament on Immigration* . Canada.ca. https://www.canada.ca/en/immigration-refugees-citizenship/corporate/publications-manuals/annual-report-parliament-immigration-2020.html#immigration2019.

Fischer, B., & Herbert, C. (2021). Emoji as affective symbols: Affective judgments of emoji, emoticons, and human faces varying in emotional content. Frontiers in Psychology, 12. https://doi.org/10.3389/fpsyg.2021.645173

Hammond, K. (2013, August 2). *Otto Neurath and the Untold History of the Infographic*. Nebo. Retrieved September 9, 2021, from https://www.neboagency.com/blog/otto-neurath-and-the-untold-history-of-the-infographic/.

Handbook for Accessible Travel. Handbook for accessible travel. (n.d.). https://www.ttc.ca/TTC_Accessibility/Easier_access_on_the_TTC/Handbook_for_Accessible_Travel.jsp.

Hallendy, N. (2020, December 8). *Inuksuk (Inukshuk)*. The Canadian Encyclopedia. https://www.thecanadianencyclopedia.ca/en/article/inuksuk-inukshuk.

Hochhäusl, S. (2013). Otto Neurath: Mapping the City as a Social Fact?: . In R. Heinrich, E. Nemeth, W. Pichler & D. Wagner (Ed.), *Volume 2 Volume 2* (pp. 99-136). Berlin, Boston: De Gruyter. https://doi.org/10.1515/9783110330496.99

Huppatz, D. J. (2020). *Design: The Key Concepts*, 17–36. https://doi.org/10.5040/9781350068186.ch-002

Iborntotravel. (2015, November 5). *Day 1 : Singapore – arrive at Singapore (It's National Day!)*. I Born To Travel. https://iborntotravel.wordpress.com/2015/11/09/day-1-singapore-arrive-at-singapore-its-national-day/.

Immigration, R. and C. C. (2019, December 31). *2020 Annual Report to Parliament on Immigration* . Canada.ca. https://www.canada.ca/en/immigration-refugees-citizenship/corporate/publications-manuals/annual-report-parliament-immigration-2020.html#immigration2019.

International Olympic Committee. (2017, February 9). *The Sports Pictograms of the Olympic Summer Games from Tokyo 1964 to Rio 2016*. The Olympic Studies Centre. https://stillmed.olympic.org/media/Document%20Library/OlympicOrg/Factsheets-Reference-Documents/Games/Pictograms/Reference-document-The-Sports-Pictograms-of-the-OG-from-Tokyo-1964-to-Rio-2016.pdf

Jeffries, S. (2019, August 27). *Before emojis: The UTOPIAN graphic language of Marie and Otto Neurath*. The Guardian.

https://www.theguardian.com/artanddesign/2019/aug/27/pictures-unite-graphic-design-vision-marie-otto-neurath.

Kamran, A. (2017). *Annotated Bibliography* [Scholarly project].

Kaye, L. K., Wall, H. J., & Malone, S. A. (2016). “Turn that frown upside-down”: A contextual account of emoticon usage on different virtual platforms. Computers in Human Behavior, 60, 463–467. https://doi.org/10.1016/j.chb.2016.02.088

Kiger, P. J. (2021, July 26). *8 facts about Ancient Egypt's hieroglyphic writing*. History.com. https://www.history.com/news/hieroglyphics-facts-ancient-egypt.

Lynch, K. (1960). *The image of the city*. MIT Press.

Lu, Y. (2016, November). *Creating a Successful Wayfinding System: Lessons Learned from Springfield, Massachusetts*. Scholarworks UMass Amherst. https://scholarworks.umass.edu/cgi/viewcontent.cgi?article=1089&context=larp_ms_projects.

Mark, E. (2016, April 7). *Chinese writing*. World History Encyclopedia. https://www.worldhistory.org/Chinese_Writing/.

McInnes, K. (2010, July 18). *Know your Icons, Part 1: A Brief history of computer icons*. Design & Illustration Envato Tuts+. https://design.tutsplus.com/articles/know-your-icons-part-1-a-brief-history-of-computer-icons--psd-9805.

Native American Petroglyphs & Pictographs: Drawings & Meanings. (2017, August 28). Retrieved from https://study.com/academy/lesson/native-american-petroglyphs-pictographs-drawings-meanings.html.

Nikolow, S. (n.d.). 'Words divide, Pictures UNITE.' Otto neurath's Pictorial statistics in historical context. *Publications of the Austrian Ludwig Wittgenstein Society - N.S. 17*. https://doi.org/10.1515/9783110330496.85

Olsen, D. R. (n.d.). Sumerian writing. Encyclopædia Britannica. https://www.britannica.com/topic/writing/Sumerian-writing.

Olympic games 1960 Rome. Olympic Games Museum. (n.d.). https://www.olympic-museum.de/ticket/olympic-games-tickets-1960.php.

Passini, R. (1996). Wayfinding design: Logic, application and some thoughts on universality. *Design Studies*, *17*(3), 319–331. https://doi.org/10.1016/0142-694x(96)00001-4

Reeves, J. D. (2021, February 21). A history of symbols. J.D. Reeves. https://jdreeves.medium.com/a-history-of-symbols-a93626435bd2.

Rogers, Y. (1989) Icon Design for the User Interface. In D.J. Oborne (ed.) *International Reviews of Ergonomics: 3*. London, Taylor and Francis, 129-155. PDF version PDF version

Roser, M., & Ortiz-Ospina, E. (2016). Literacy. Our World in Data. https://ourworldindata.org/literacy.

Skager, K. (2021, June 21). *What are emojis and how to use them in advertising*. Promotional Products Blog. https://www.qualitylogoproducts.com/blog/emojis-in-advertising-faq/.

Skovholt, K., Grønning, A., & Kankaanranta, A. (2014). The communicative functions of emoticons in workplace E-mails: :-). *Journal of Computer-Mediated Communication*, *19*(4), 780–797. https://doi.org/10.1111/jcc4.12063

Shaughnessy, A. (11/01/2015). Lance wyman's mexico city metro pictograms Marketing Week.

Team, N. E. (2015, March 24). International Language: The Emergence of Icons and Pictograms. https://www.noupe.com/design/the-emergence-icons-pictograms-58839.html

Statistics Canada. 2017. Toronto [Census metropolitan area], Ontario and Ontario [Province] (table). Census Profile. 2016 Census. Statistics Canada Catalogue no. 98 - 316-X2016001. Ottawa. Released November 29, 2017. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E

Swan, H., Pouncey, I., Pickering, H., & Watson , L. (n.d.). *Inclusive design principles*. Inclusive Design Principles. https://inclusivedesignprinciples.org/.

The Association of Registered Graphic Designers of Ontario (RGD Ontario). (2010). *Access Ability: A Practical Handbook on Accessible Graphic Design*. RGD. Retrieved September 10, 2021, from https://www.rgd.ca/database/files/library/RGD_AccessAbility_Handbook.pdf.

Toronto PATH Network. City of Toronto. (n.d.). https://www.toronto.ca/wp-content/uploads/2018/03/8d6c-path-network-map.pdf.

Van Hoepen, C. (2019, April 22). *Developing: Premier Doug Ford announces $28.5 billion in funding for GTA transit*. The Toronto Observer. Retrieved September 11, 2021, from https://www.google.com/search?q=pape%2Bstation&client=safari&rls=en&sxsrf=AOaemvLr4oL7w3mKzXd12f45fUe4ERh-wg%3A1631337867300&source=lnms&tbm=isch&sa=X&ved=2ahUKEwif2tqQI_byAhVDZN8KHcd-CVcQ_AUoA3oECAEQBQ&biw=1440&bih=820#imgrc=HXp4B6wYG9nTvM.

Vella, E. (2018, July 9). *Nearly 5% of toronto population can't speak English or French: Report - Toronto*. Global News. https://globalnews.ca/news/4320941/toronto-population-english-french-languages/.

Vidovic, G. (2016, August 4). *Icons - the only language everyone understands*. Medium. https://world-of-icons.com/icons-the-only-language-everyone-understands-daf6d8f5009.

Welch, S. J., Cheung, D. S., Apker, J., & Patterson, E. S. (2013). Strategies for improving communication in the Emergency DEPARTMENT: Mediums and messages in a noisy environment. The Joint Commission Journal on Quality and Patient Safety, 39(6), 279–286. https://doi.org/10.1016/s1553-7250(13)39039-4

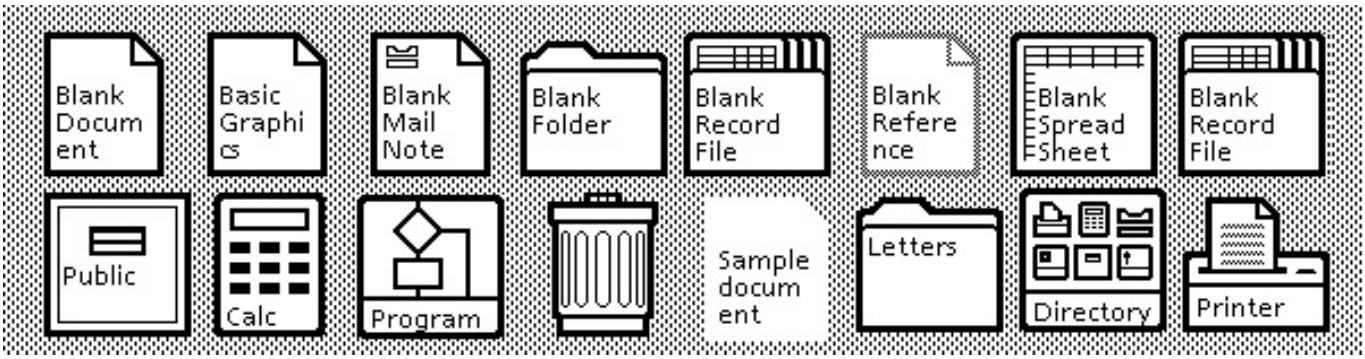
Zender, M. (2006). Advancing Icon Design for Global Non Verbal Communication: Or What Does the Word Bow Mean? *Visible Language, 40*, 178.

Zhang, L. (2014, February 18). *Times new roman vs. arial*. Space of Imagination. Retrieved September 10, 2021, from https://liyuangraphicdesign.wordpress.com/anatomy-of-times-new-roman-and-arial/.

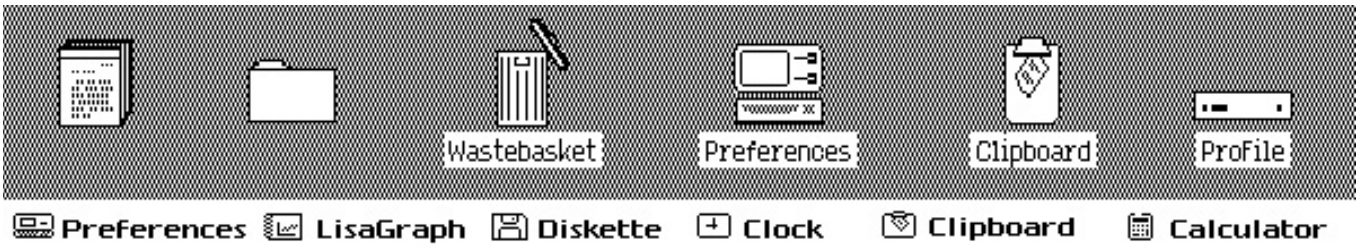
Zhang, P. (2019, July 21). *The story of Chinese characters*. www.theepochtimes.com. https://www.theepochtimes.com/the-story-of-chinese-characters_3010678.html.

Appendices

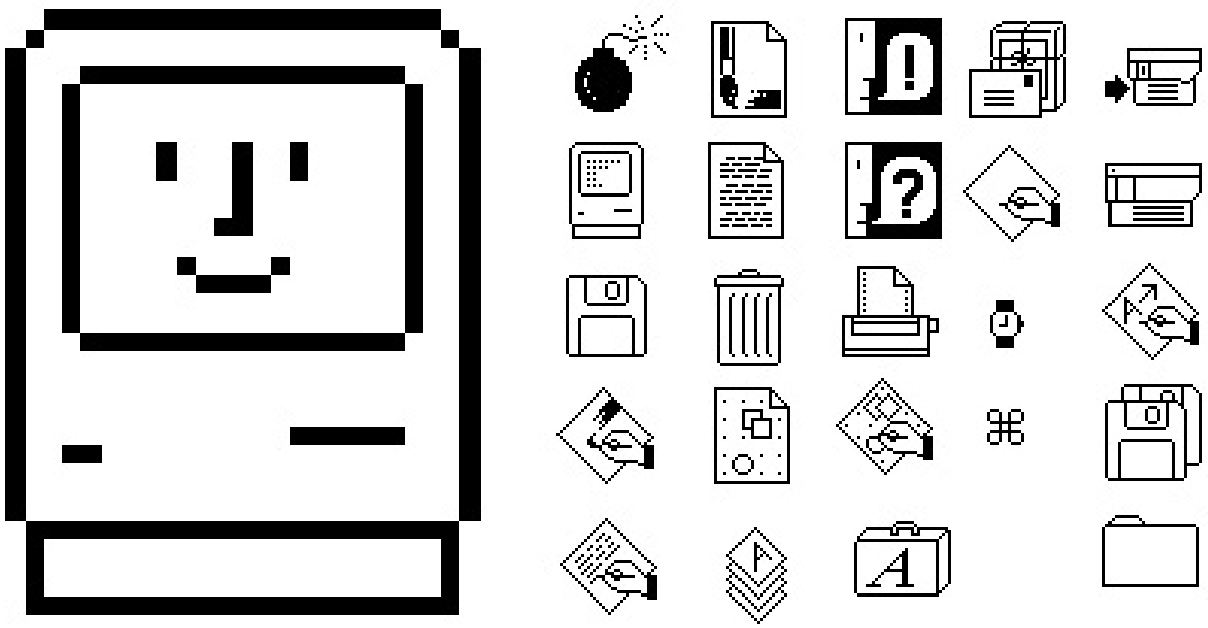
Appendix A: The Development of Computer Icons



Note: image of 1981 Xerox 8010 Star.

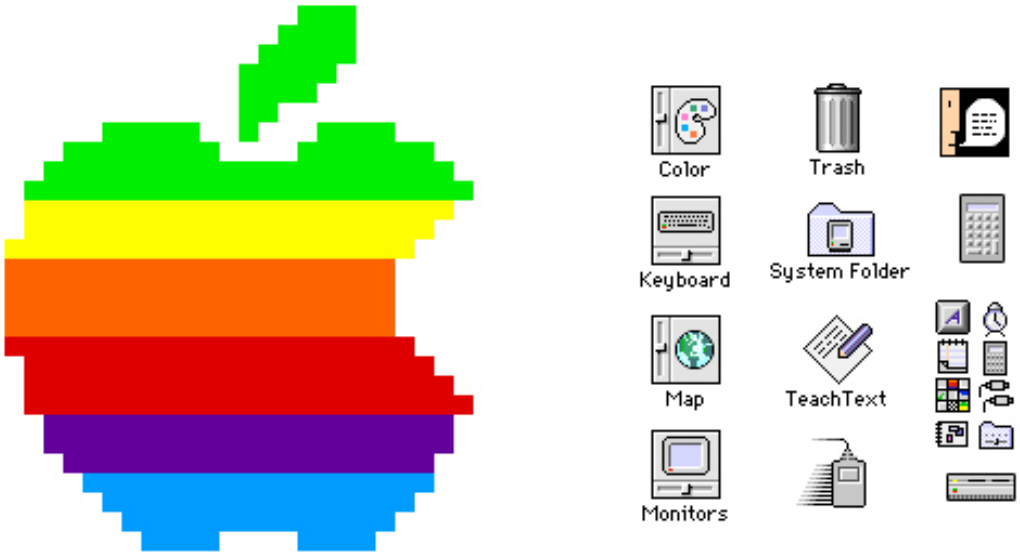


Note: image of 1983 Lisa Office System 1.



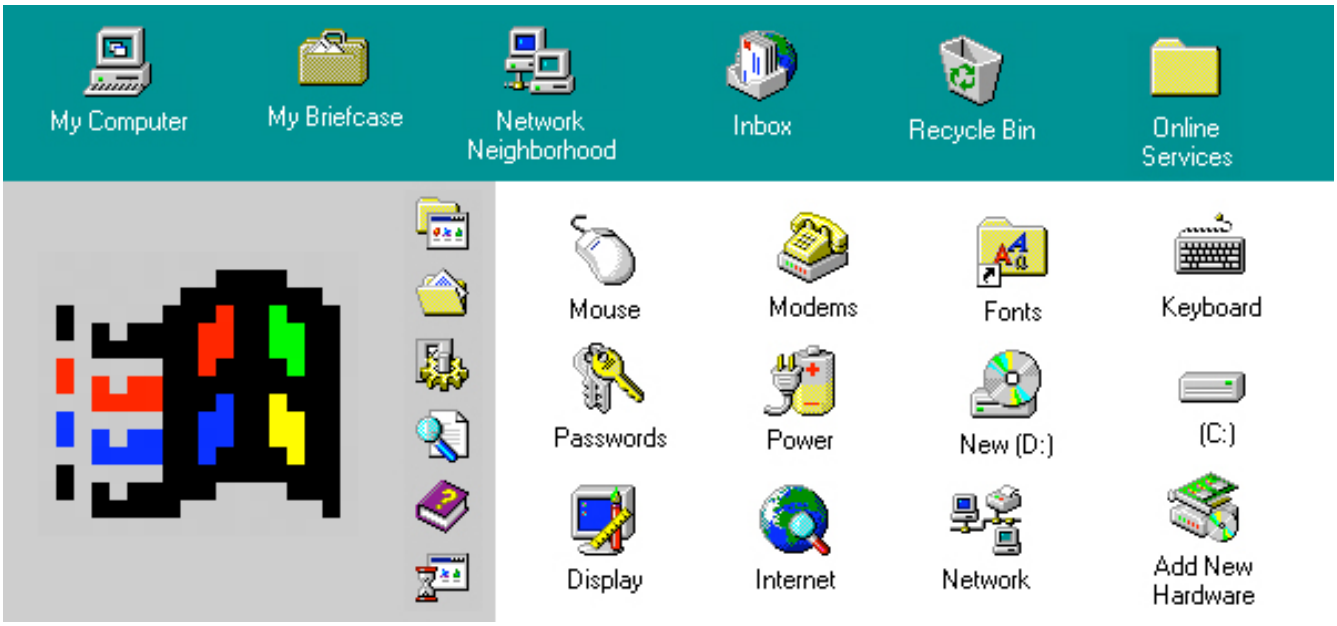
Note: image of 1984 Apple Macintosh 1.0.

Note: image of Commodore C64 GEOS.

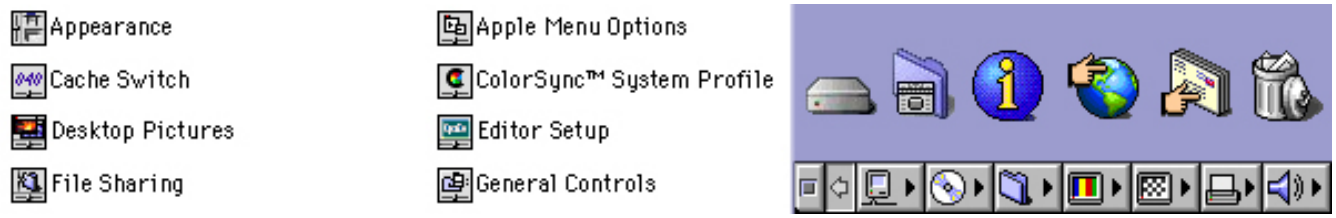


Note: image of 1991 Macintosh System 7.

Note: image of 1992 Windows 3.1.



Note: image of 1995 Windows 95.

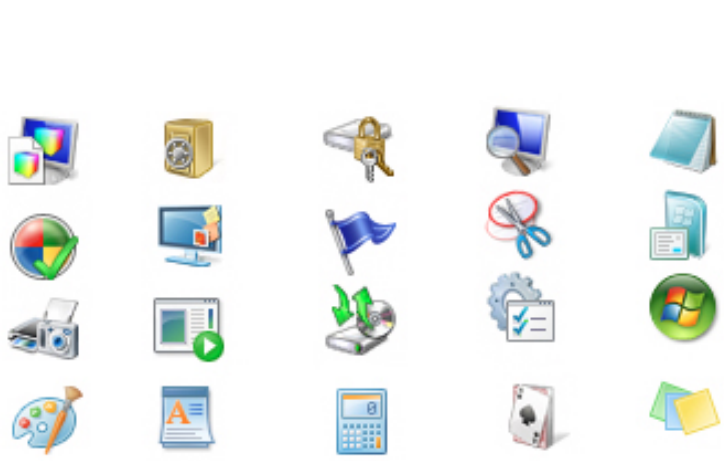


Note: image of 1997 Macintosh OS 8.

Note: image of 2001 Mac OS X v10.0.

Note: image of 2001 Windows XP.

Note: image of 2007 Mac OS X Leopard.



Note: image of 2009 - Windows 7.

McInnes, K. (2010, July 18). *Know your Icons, Part 1: A Brief history of computer icons*. Design & Illustration Envato Tuts+. https://design.tutsplus.com/articles/know-your-icons-part-1-a-brief-history-of-computer-icons--psd-9805.

Appendix B: Current TTC Subway Signage

Note: example one of St. George Station.

Note: example two of St. George Station.

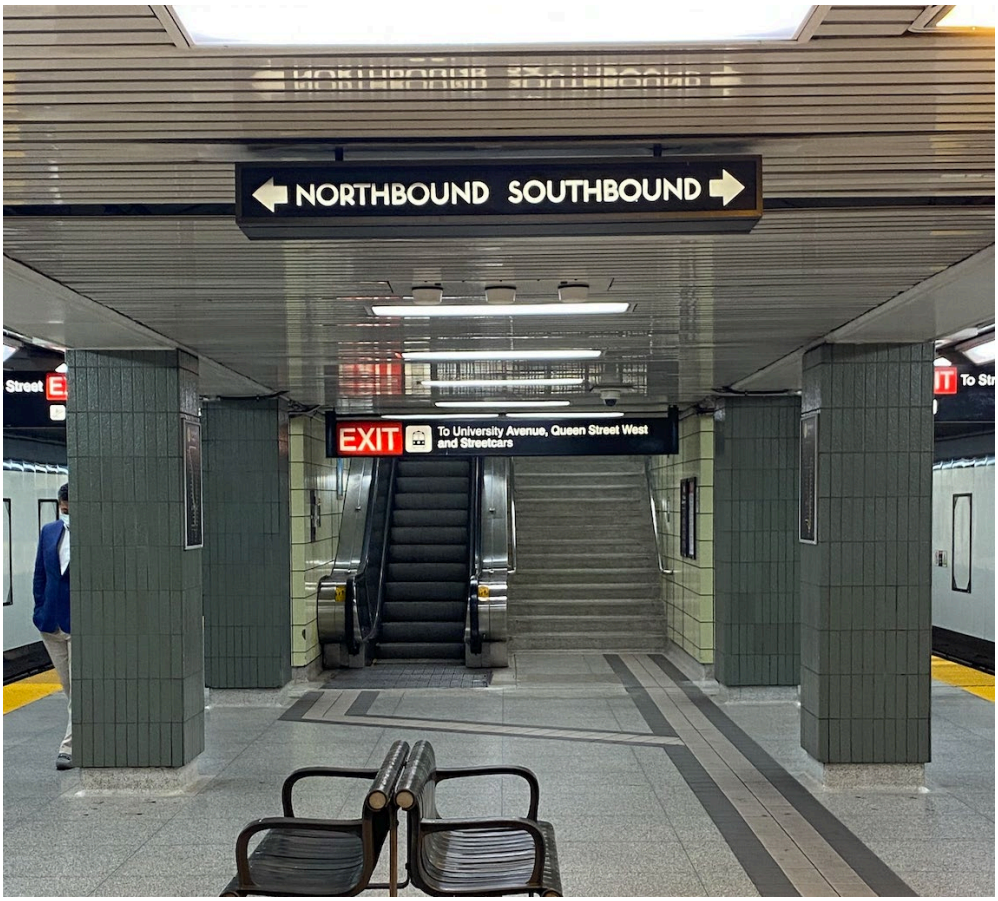
Note: example three of St. George Station.

Note: example one of Queens Park Station.

Note: example two of Queens Park Station.

Note: example three of Queens Park Station.

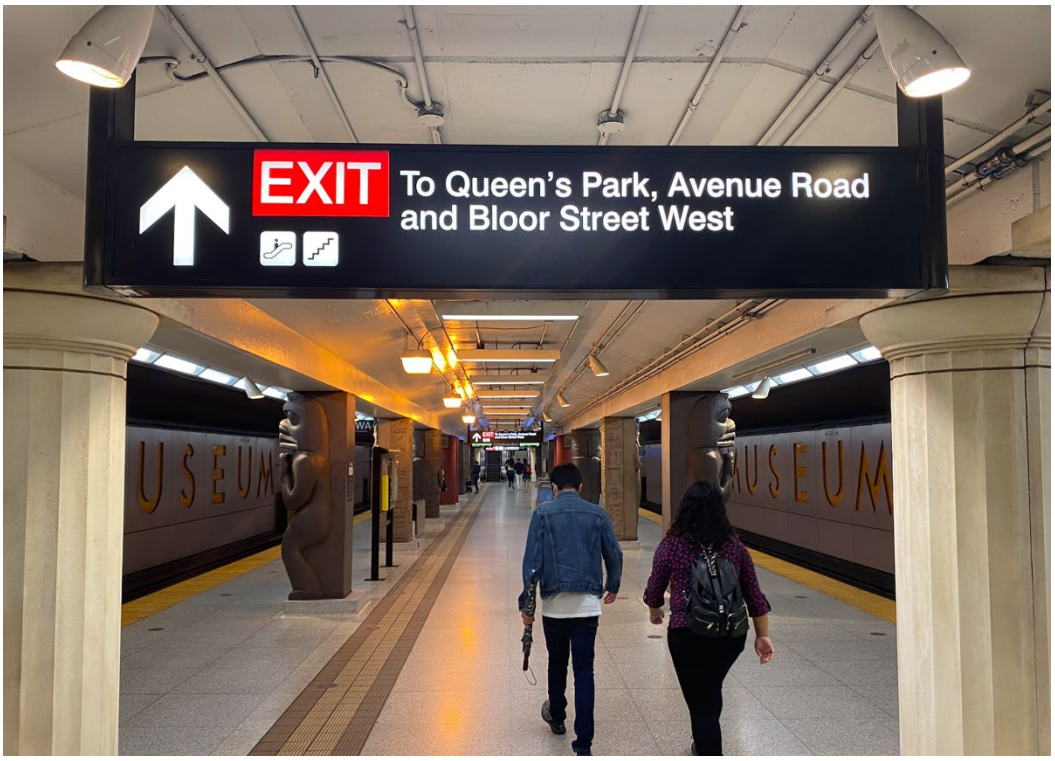
Note: example one of Osgoode Station.



Note: example two of Osgoode Station.

Note: examples three of Osgoode Station.

Note: examples one of Museum Station.



Note: examples two of Museum Station.

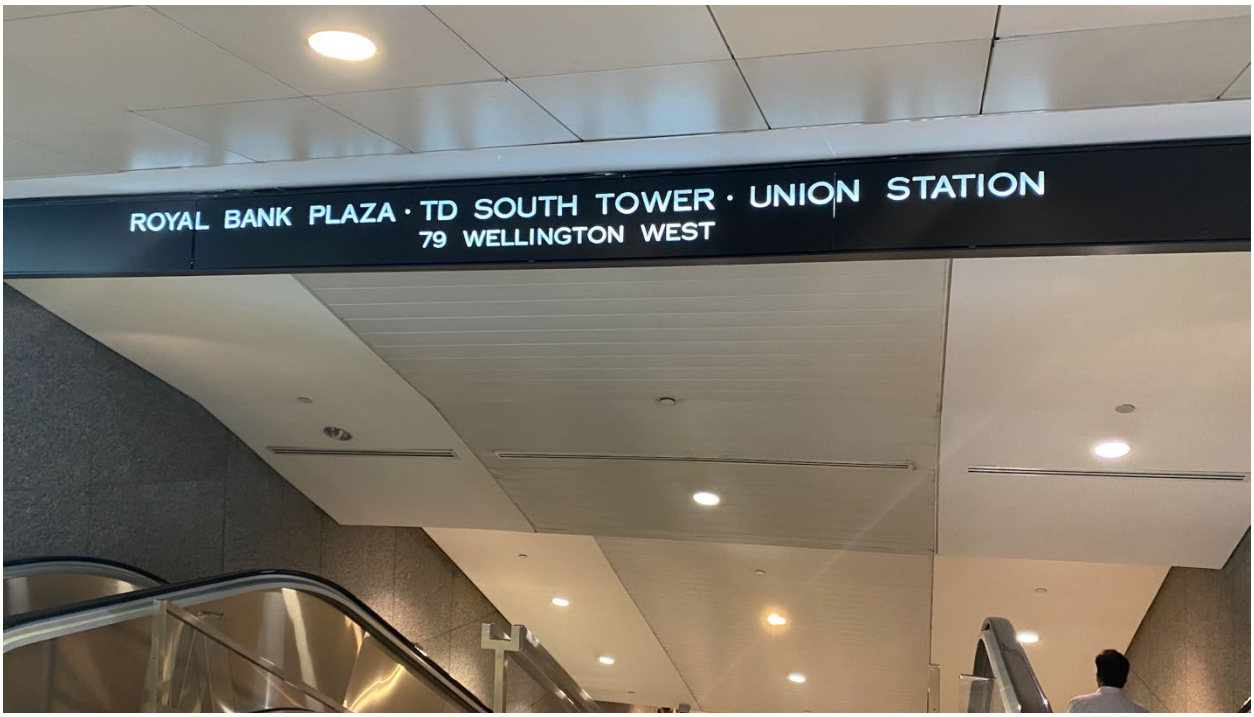
Note: example one Union Station.

Note: example two of Union Station.

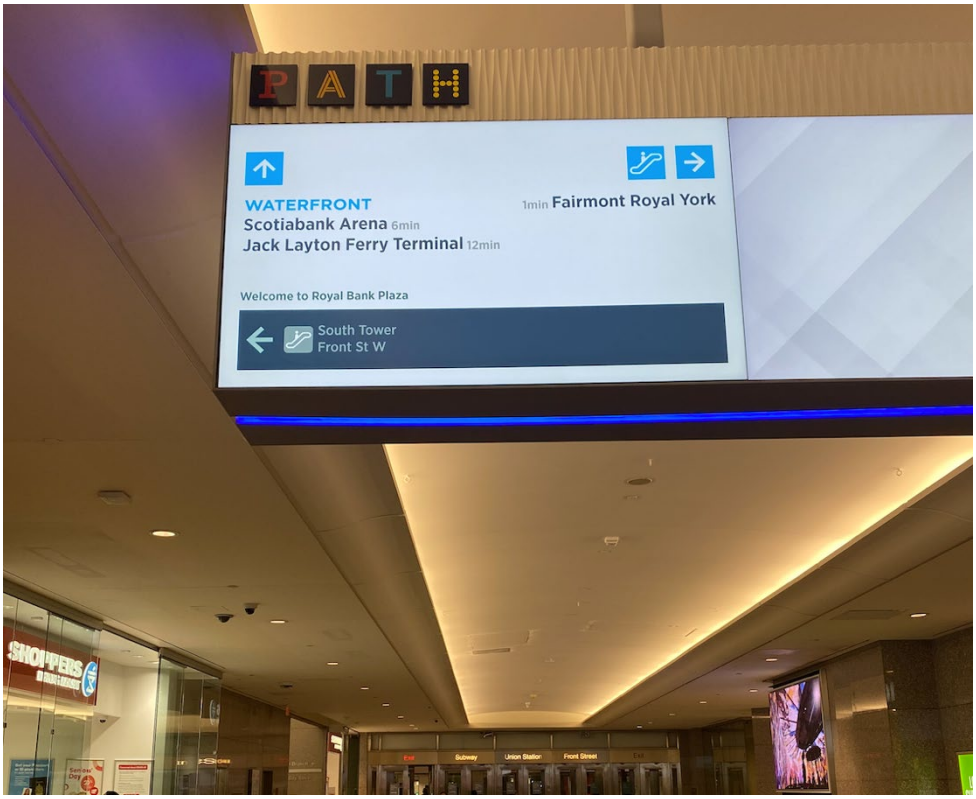
Appendix C: Current PATH Signage

Note: PATH signage in the TD Tower.

Note: PATH signage in the TD Tower.



Note: PATH signage leading to the Royal Bank Plaza.



Note: PATH signage in the Royal Bank Plaza.

Appendix D: Inclusive Design Signage Manual

INCLUSIVE DESIGN
SIGNAGE MANUAL

LAYOUT SPECIFICATIONS

*The **exit** sign must be at the top.*

*The **station pictogram** does not need to appear on every sign but when it does, it must always be placed at the top left corner with the name of the station underneath.*

*The **QR code** should always be placed at the bottom left corner.*

*A **white line** should seperate different navigational communication for wall signage.*

*The **subway line** and **navigational direction** must always be together and preferably, on the right side of the sign.*

***Directional arrows** must come before any text or pictograms (not including the station pictogram).*

*The **pictogram** must be followed by **identifying text** (not including the station pictogram).*

INCLUSIVE DESIGN
SIGNAGE MANUAL

LAYOUT SPECIFICATIONS CONTINUED

*The **station pictogram** must be centered with the visual leaving at least an inch of space above and below it.*

Station name should be 200pt.

*The **station pictogram** and **QR code** must be the same relation in height and width on every sign with a minimum of 6x6in.*

***Pictograms** should be a minimum of 5x5in.*
***Line numbers** and **directional arrows** should be a minimum of 4x4in.*

There should be at least 1in space at the top and bottom of the sign.

***EXIT** text should be 600pt.*

***Accompanying written information** such as street name, or direction should be 400pt.*

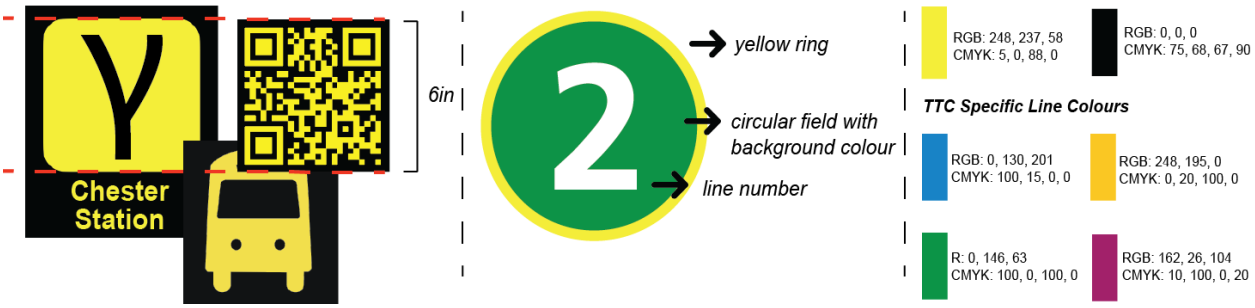
Space between pictograms or text should be 2in.

INCLUSIVE DESIGN
SIGNAGE MANUAL

SIGNAGE SPECIFICATIONS

Pictograms

- *A pictogram must be a minimum of 6in in height according to ADA standards.*
- *A QR code must be a minimum of 6in in height to ensure consistency with the pictogram.*
- *The station pictogram must always be on top of a yellow background.*
- *Navigational pictograms (such as a bus) should be yellow on a black background.*
- *The line number pictograms must be white, be set in a circular field with the background colour associated with the TTC line colour and have a yellow ring outlining it.*

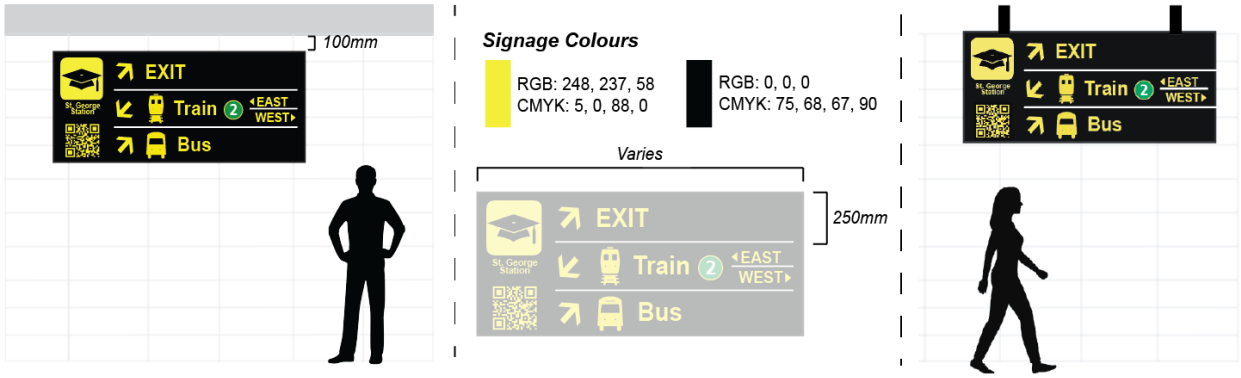


INCLUSIVE DESIGN
SIGNAGE MANUAL

SIGNAGE SPECIFICATIONS

Signage

- *The signage should have a finish that is matte or non-glare.*
- *The colour should be black with yellow text to ensure high contrast.*
- *The width varies while the height per panel is 250mm (no signage should exceed three panels).*
- *Signage should be repeated every 20ft on a straight walkway. If the area has columns or other environmental blockages, the signage should be placed more frequently, approximately every 10ft to ensure consistency and user readability.*



INCLUSIVE DESIGN
SIGNAGE MANUAL

DESIGN PRINCIPLES OF STATION PICTOGRAMS

→ *This **station pictogram** is of a graduation cap representing St. George Station as it is close to the University of Toronto.*

→ *This **station pictogram** is of a cross representing Queen's Park Station as it is close to both Mount Sinai and Toronto General Hospital.*

→ *These pictograms must be **unique to each station**. They can be an iconic representation of the built environment or symbolic representation influenced by cultural. The purpose of these station pictograms is to allow an individual to better orient themselves to the physical environment above.*

Station pictograms can be influenced by cultural representation if a well-known iconic representation is not present.

In the example above, one can see how Pape, Broadway and Chester Station are used as cultural pictographic representations in the form of letters from the Greek alphabet, due to their physical proximity to Greektown in Toronto.

INCLUSIVE DESIGN
SIGNAGE MANUAL

SIGNAGE SPECIFICATIONS

Typography

- *The typeface must be Arial to ensure consistency with a mix of both uppercase and lowercase lettering to use as emphasis.*
- *Uppercase lettering is to be used for EXIT signage and any other communication that warrants emphasis.*
- *Lowercase lettering is to be used for all other communication that acts as a descriptor or adds informational value.*
- *The integrity of the font should be maintained at all times. No vertical or horizontal scaling, no added stroke, etc.*
- *Font size should be approximately 600pt to ensure visibility from a distance.*

→ *mix of uppercase and lowercase letters. East/West are important because they help orient users so they are in uppercase lettering. Train is in lowercase lettering as it is a descriptor of the pictogram.*