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Pictograms and User Interface Icons: Predictions for Future Usage

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1. Introduction

As the level of technology increases, people must often deal with large amounts of information. Part of this experience is using information as pictures. Emoji have recently become a global and cultural phenomenon, making a huge impact upon interpersonal communication. Yet before the smiling faces and hearts, other pictures have quietly been doing their important jobs. Pictograms guide our everyday lives, relaying messages that assist in times of need, protect well-being, and sometimes warn us of extreme danger. Icons allow us to interact with machines quickly and easily - for work, entertainment, and tasks necessary for our busy lives. From the pictorial signs we might seek out in foreign airports to the small symbols on our computer screens and mobile devices, pictorial information remains something that amuses, informs, assists, and protects us at every turn.

This essay will make predictions as to how two types of pictorial information might be used in the future: (1) Pictograms; (2) User interface icons. Readers of the future, who will be using pictures in ways both familiar and unfamiliar to us of the year 2020, are invited to judge the accuracy of these estimations.

2. Predictions for Pictograms.

2.1 Pictograms will continue to play an important role in daily life.

Pictographic information has proven to be a practical and effective means of communicating a message. Abdullah and Hubner (2006) define a pictogram as “an image created by people for the purpose of quick and clear communication without language or words, in order to draw attention to something” (p. 52). These images help us with a wide range of basic human needs, and this highly functional quality is unlikely to change in the foreseeable future. Regardless of our time and culture, people will need to know quickly and easily the location of entrances and exits, elevators and escalators, toilets, places to care for children, and where to get food and drink. People will want to know how to dispose of their garbage, and governing bodies will want to be able to tell people what they can, can’t, should and shouldn’t do in public spaces. Along with offering guidance and advice, pictographic information also deals with potentially life and death situations, such as road signs, poison warning labels, and workplace health and safety

information. Pictograms truly play a crucial role in assisting us with our most basic needs, wants, and even our personal well-being, and will continue to do so.

With global travel not showing any signs of slowing, the need for a quick and effective means of communication in transit locations such as airports and other places frequented by people unfamiliar with local languages should only increase. Pictograms have the capacity to transcend language barriers with ease, as unlike written text, they do not require the understanding of a linguistic code. Such pictorial information has been shown to have advantages over written text. A study by the Department of Trade and Industry in the UK (Davies, Haines, Norris & Wilson, 1998) found that pictograms have "the potential to be interpreted more accurately and more quickly than words", and that "they can sometimes be recognized and recalled far better than words" (p. 2). The relationship between words (sounds and written text) and meaning is for the most part purely arbitrary. Pictograms, however, can have an iconic or analogical quality, that is, they can actually resemble what they represent. As long as the image and its intended meaning is understood, then its message will be successfully communicated. Meaning is conveyed quickly and clearly, as with a traveler in any country knowing that an airplane shape tilting up means *departures* and understanding that any basic male/female form generally means *toilets*. Having the power to depict intended meaning in the absence of any written language guarantees that pictograms will continue to be an important communicator of messages in an increasingly globalized world. See Figure 1 for examples of current airport pictograms.

2.2 Pictogram usage will always be limited.

Despite the proven advantages of communicating messages via pictures, and regardless of how they might manifest within future technologies such as holographic projection, virtual reality (VR) or appearing in augmented reality (AR), the use of pictographic information will always be contained. Crucial to the effectiveness of the simple pictures is their ability to be properly understood, that is, to have the capacity to convey their intended meaning accurately. Unlike most written language, in which textual forms represent the sounds of a language, pictures are far more ambiguous and open to interpretation by the observer, making them more suspectable to misunderstanding or not being understood at all. This failure to convey meaning might be due to cultural and individual interpretations of the pictogram, where different images mean different things to different people. Other factors might involve the sign's placement in the environment, or the influence of accompanying signs. Failure may also be due to a lack of required knowledge, as with an inexperienced traveler unaware that the generally accepted meaning of a key combined with a car is *car rentals*.

In order to be successful, pictograms require a set context – a limitation that will restrict their understanding within a particular and established environment. The limitations of symbols became apparent in 1974, when the United States Department of Transport and the American Institute of Graphic Arts joined forces to devise a set of symbols to be commonly recognized in

transportation facilities, such as bus stations and international airports. This collaboration resulted in a set of 50 pictograms being completed in 1979. Robinson (2009) notes some significant findings from the project's design committee: The effectiveness of the signs was strongest when used to represent a service or a concession using one object, such as a bus. However, when representing an activity or a process, like the purchasing of a ticket, the signs were far less effective. Additionally, the committee concluded that pictograms require the support of some written text in order to accurately convey their intended meaning.

Today, airports around the world feature the same basic symbols for various services accompanied by text, and apart from symbols resulting from cultural and technological changes such as unisex toilets and wi-fi symbols, the number of airport symbols does not appear to have grown significantly since 1979. Pictograms, despite their instant recognition and non-reliance upon linguistic knowledge, seemly will always be restricted to a basic set. According to Tijus et al. (2007), their polysemic quality requires some context "to disambiguate a pictogram's intended meaning" (p. 10). Whether it be during travel, driving, or in the workplace, successful pictogram usage requires a limited number of images working within a well-defined and established environment. They cannot effectively be used to represent a complicated process or activity, and often require the semantic backup of textual information. In the future, these signs will continue to show us the way with a high level of efficiency, yet within their confines.

2.3 Iconic pictograms will dominate the symbolic.

Pictograms can represent their referents in different ways. They can be literal (or iconic), that is, depict what they are representing as with a picture of a fire extinguisher meaning *here is a fire extinguisher.* Despite not existing in reality, even an arrow indicating direction is to some extent pictorial. The shape veering off to the left (meaning *go left here*) is analogical to its referent, as its "structure resembles that of the real world" (Eysenck & Keane, 1990, p. 204). The arrow follows a path that can be physically taken. A red diagonal line across an image does not have the same analogical quality as that of an arrow. It is more symbolic as it requires an understanding that the addition of a red diagonal line (which has little relation to the real world) in front of an image means *prohibited*. Combining the symbolic red line with an iconic image, for example that of a person swimming, creates a sign with a clear message: *no swimming*. When this sign is combined with another iconic image, such as a crocodile shape as found along many rivers in northern Australia, the intended meaning becomes (hopefully) loud and clear: *not a good place to swim*. But what of something that cannot be so easily depicted, such as a harmful virus? The internationally recognized biohazard symbol warns people of such dangers. According to Cook (2001), the symbol's designer, Charles Baldwin, explained: "We wanted something that was memorable but meaningless, so we could educate people as to what it means". The designer seems to have been aware of the extreme difficulties of depicting biological hazards (i.e., microorganisms, viruses, toxins), so he decided to concentrate solely on

the symbol's impact and informing the general population of its meaning. The success of the symbol, first developed in 1966, has relied upon it being recognized. Due to its symbolic nature the observer needs to know what the image means in order for it to work. Without this knowledge (and unlike the intrinsically meaningful image of a crocodile) its circular curves remain meaningless despite its dire warning. See Figure 2 for crocodile warning and biohazard symbols.

The difference between iconic and symbolic representation is evident in the updated version of the radiation warning symbol. Whilst many people understand the huge importance, danger and gravity of what the original trefoil design represents, some people do not. The Goiânia accident involved the handling of abandoned hospital equipment containing radioactive material, resulting in widespread contamination and loss of life. In order to avoid future such incidents, a new symbol was launched by the International Atomic Energy Agency (IAEA) in 2007. The red sign (as shown in Figure 3 along with the previous symbol) features the widely known trefoil design supplemented by two iconic pictograms: the well-known 'skull and crossbones' representing death, and a person running with an arrow indicating *exit* or *get away*. Even if the viewer does not understand what the trefoil design means (or even the concept of radiation) the wavy lines radiating from the symbol and pointing to the iconic representations of death and a person fleeing may get the intended message across. According to Dahlstrom (2007), the symbol "will serve as a supplementary warning to the trefoil, which has no intuitive meaning and little recognition beyond those educated in its significance". The previous design was not as effective as it was purely symbolic; the observer being required to already have specific and prior knowledge about radiation. The new design, however, has the capacity to provoke a more visceral response from the observer, thereby exploiting the human survival instinct to get its message across.

Regardless of the importance of what they are representing, iconic pictograms will always be more effective at communicating their message than those symbolic. Pictures of actual things that exist in the world are more easily depicted (e.g., houses, airplanes) than abstract concepts (e.g., reservation, rental). However, some symbolic elements will always be required in pictographic design so as to make the images functionable, as with signs that follow international standards such as a green circle meaning permission, a yellow triangle for caution, or a red circle (often with a diagonal line) expressing prohibition. At the core of most pictograms is a tangible object. When framed within meanings such as *you can*, *be careful*, or *don't,* the design principle that pictograms "should be immediately understood, revealing their message or information at a single glance" (Abdullah & Nubner, 2006, p. 52) is realized. Pictograms of the future will not be sets of mysterious, hieroglyphic style symbols requiring special futuristic knowledge in order to be understood. Rather, they will mostly be depictions of actual objects, and generally conform to an agreed set of basic design rules of a symbolic nature (which originated in the 20th century) to indicate their specific function.

3. Predictions for User Interface Icons.

3.1 As technology advances, icons will continue to play a central role in human/machine interface.

As the information age progresses, it has become increasingly necessary for humans and machines to communicate. Punch cards are now museum pieces, as the average person navigates an assortment of devices and their operating systems, from smartphones, PCs, ATMs, and more recently cashless payment machines in a growing number of establishments including supermarkets, clothing stores, restaurants and hotels. A significant part of these exchanges involves icons – small, simple pictures representing certain functions. One look at the edge of a computer screen, and a seemingly ever-growing number of small images can be seen. Regardless of the operational system, people of today have a general sense of what these symbols mean. Users can adjust the volume, screen brightness, check their Wi-Fi signal strength and battery levels with ease. An image of a house will take users back to the start, a left-facing arrow one step back, a cog or a wrench may allow us to adjust a setting, and a shopping cart will tell us what we have on order. Without great fanfare, icons have quietly become central to human/machine interface.

There must be good reasons as to why the use of computer icons has persisted since their creation in the 1970s. From a cognitive viewpoint, processing pictorial information through the use of icons might help to make computer operation easier. A general consensus amongst researchers is that human working memory is domain specific, that is, a clear division exists between visual and verbal processing systems (Wen, 2016). While using a computer often involves the managing of linguistic information as with word processing software, using non-linguistic information (e.g., an arrow or a picture of a pair of scissors) may alleviate the cognitive burden upon working memory. Once the user establishes a connection between the icon and its meaning, information (i.e., the function the icon represents) can be presented in one small, simple image, which can bypass the need for the decoding of a language. It is reasonable to assume that a user interface system presenting written text only would fail, as users would reject the cognitive ‘labor’ of having to deal with language only.

On a more practical level, the wide acceptance of icons may simply be due to their size and shape. Space is at a premium on a screen. Small, compact images are often a much better fit than words or short phrases. For example, a calculator (or function thereof) is represented more efficiently as a small rectangular shape, rather than the ten letter English word. Despite being able to scroll through an infinite number of screens, a screen of information like that on smartphone can only be presented to the user one screen at a time, and this space is at a premium. Wearable technology such as smart watches, the soon to be mainstream smart glasses for AR and goggle-type devices for VR (and in the not so distant future perhaps amulet-style devices or even skin implants) require and will continue to demand an efficient use of screen space, regardless of the level of technology. It is therefore apparent that icons are not ready for

the history books any time soon. For whatever reasons, icons have become an integral part of human-machine interface ever since the level of technology has allowed for their usage. This important role for the little pictures has shown no sign of diminishing and appears to only be more essential as technology progresses.

3.2 A limited number of icons will dominate and continue to be used for generations.

Despite their relatively short history, each icon (like a word in a language) tells a story. Some hark right back to the original set of icons designed in 1973 as the first Graphical User Interface or GUI for the *Xerox Alto.* These images mainly depicted concrete objects; the user being presented with tangible and familiar office items such as a sheet of paper. The icons served as an analogy for a specific software function. Interestingly, some of these original icons are survivors as they have persisted virtually unchanged, as shown in Figure 4. Icons such as the original *Xerox Alto* icons can be described as prescriptive as they were intentionally designed to represent a specific function. An example of a prescriptive icon is the *power symbol*, an incomplete circle with a line at twelve o'clock, introduced by the International Electrotechnical Commission (IEC) in 1973. Users nowadays are generally unaware of the symbol's actual meaning (a binary 'I' meaning *on* and an 'O' meaning *off*) but know what the symbol does and will seek it out when looking for a power button. Another is the *share* icon, consisting of three circles connected by two lines. Originally designed by Alex King in 2006 "to represent the generic action of sharing a web page" (King, n.d.) and subsequently released under Creative Commons licencing, this simple icon appears to have been widely accepted by the user community, as it continues to appear in a variety of platforms to perform the vital social media task of file sharing.

Many user interface icons appear to succeed due to their: (1) simplistic design, (2) ease of understanding, (3) logical consistency with what they are representing. It is sometimes difficult to pinpoint their exact origins, as some icons can be described as having developed 'organically' as opposed to being deliberately planned. One successful design is the *home* icon that takes users back to the start screen, just like when people return to their home. The icon is simple, compact, and the extremely familiar house shape even when presented in a variety of generic forms has sealed its success. Others such as the *Wi-Fi* symbol and the *signal strength* symbol also share these three qualities, using a small series of lines analogous to electromagnetic waves indicative of signal strengths. These symbols, vital to our connected world, have the advantage of being able to act as small electronic gauges, using their animated quality to alter their message in real time. Yet regardless of what they can do, how they came into being, and the importance of their referent, icons all require general user acceptance in order to be successful. Human beings are fastidious and picky when deciding what will represent what. Like words that become popular, accepted, and eventually formally admitted into a language, an icon will go through a similar process of natural selection by its general population of users, with only the strongest surviving to become part of the user interface icon vernacular.

However, icons do not necessarily have to make perfect sense in order to be accepted. A significant example is the *save* icon. Despite the floppy disk being a relic of 20th century computing, its likeness (see Figure 5) is often used to represent the vital function of save. Older users who may have experienced 8-inch, 5.25-inch, and 3.5-inch floppies will already have a strong connection to the image's meaning, but what of younger users who may never have seen an actual floppy disk? Any assertion that the *save* icon needs to be replaced, such as that of Darby (2018) who believes that replacing the icon seems to be "a challenge designers should take up" appears moot. The *save* icon continues to work well despite the age of its users, and any new icon would require a process of unlearning the old symbol. The reason why the icon persists might be due to the concept of save being difficult to picture. The idea of download, which evokes a feeling of physical movement (i.e., something coming into a user's device) has been successfully depicted by an icon consisting of an arrow pointing down to a simple tray shape or just a line. It may be the case that the less 'tactile' a concept, the more difficult it is to present it as an icon. The concept of save (preserving, keeping) is more abstract and therefore more difficult to effectively depict. The floppy disk *save* icon is anachronistic, yet there appears to be no significant public outcry for its replacement due to it being impractical. The *save* icon may continue its generational transference for many years to come – passed down successfully despite the squarish object it actually depicts becoming of less and less relevance to the icon's actual function.

Just as certain words succeed and can stay with a language for centuries, some user interface icons may persist, especially when the very basic functions of information processing: encoding, storage and retrieval, are being represented. An example of generational transference of icons can be seen in media control symbols (e.g., a right-facing triangle for *play*, a square for *stop*, two left-facing triangles for *rewind*). The symbols originated in the 1960's, some of which were designed for reel to reel audio equipment ("Media control symbols", n.d.). As technology has progressed, these symbols have persisted in a multitude of media devices, such as tape players, VCRs, and DVD machines. The symbols are now prevalent when using practically all digital medium, as the YouTube play button logo will attest. The symbols' usage has even been extrapolated into non-media devices such as washing machines, where the *play* icon means *start the wash cycle*. A child of the 2020's can learn and use the same symbols their grandparents had used decades earlier to operate media playing machines. Similarly, people of the future will use computer interface icons (or generic adaptations thereof) that were conceived and in use generations prior. These icons will have a history of not only having been accepted and adopted by the user community, but also of having adapted (or rather having been adapted) to survive major technological change, as with the transformation from analog to digital machines and medium.

3.3 Icons will never become a language.

Icons can transcend linguistic boundaries, and their ability to communicate information quickly and effectively is remarkable. However, despite their allure, icons can never become a written language. The magic of writing is in its capacity to link symbols and sounds, thereby consistently creating a readable version of the spoken word. This is not possible when representing words pictorially. Gros (2011) developed an "icon language" claiming that "visual grammar is more insightful and less complicated than any alphabetical grammar" and that his iconic language "also enables a definite visualization of abstract concepts" (p. 38). Yet upon 'reading' a sample of the pictorial forms (included in Figure 6) the ambiguity and general confusion of meaning the icons display is apparent. The only thing that makes the pictures truly understandable is an accompanying English translation of the 'sentences'. Like *Emoji Dick*, the crowd sourced and funded – in all fairness probably done in jest – emoji version of Herman Melville's classic novel *Moby Dick*, the extreme limitations of having pictorial symbols do the work of letters, words and sentences quickly becomes self-evident. See Figure 6 for an extract of *Emoji Dick*. Robinson (2007) believes that a pictorial language is a dream that can never become real, stating that: "Writing and reading are inextricably bound to speech, whether or not we move our lips" (p. 17). Icons of the future will serve brilliantly as icons, but they will never even come close to acting as a true language.

Icons (as do pictograms) require context – an operational field in which symbols can make sense within a limited scope of understanding. Language is also highly dependent upon context, both "situational" and "linguistic" (Ellis, 1994, p. 698). Yet writing, due to its ability to use a finite set of symbols to create the infinite, can express, refine, support and clarify its messages in ways that pictures will never have the capacity to do. However, when given a contextual environment, whether it be a smartphone operating system, an online computer game, or even a high-tech toilet operating system – Japanese toilet icons have recently become officially standardized – icons excel. The world of searching, cutting, pasting, copying, saving, sending and refreshing is conducive to icons, just as airport pictograms are extremely accommodating to international travellers. According to Silver (2019), an estimated five billion people have mobile devices worldwide. This means that a huge proportion of the human population is currently navigating their own personal and transportable information environment. As new technologies continue to develop, including VR, AR, and systems for smart homes, cars and appliances, new environments will continue to emerge creating a demand for sets of user interface icons, some new and others antique.

The number of icons users are required to know has been steadily and stealthily increasing. It is reasonable to assume that most information technology users would know the meaning of all the icons mentioned thus far, including other classics such as the magnifying glass for *find* or *search*, the circular arrow for *refresh*, and the padlock meaning *security*. This knowledge is not formally learned in school, but rather gained through more implicit means - years of personal interaction with a variety of devices. However, the number of icons a person needs to know is unlikely to

grow into a list of thousands requiring many hours of study, as with Chinese or Japanese logographic characters. Nor will a modern-day set of hieroglyphs emerge, in which each glyph represents a word. There appears to be a critical mass for the number of icons in general usage. People like to use icons, but if learning, remembering, and recalling them becomes a labour, then users will be more inclined to fall back upon the comfortable and familiar – their language in written form, rendering the burdensome symbols obsolete. The number of user interface icons may steadily increase, with a few dozen core-function symbols persisting for perhaps hundreds of years, but the evolution of an icon language is highly unlikely.

4. Conclusion

In the future, pictograms will continue to communicate their messages, from assisting people with basic human needs to preventing harm and death. Their capacity to function without the use of a language will continue to see them highly valued in an increasingly globalized world. Pictograms will always be impactful and effective. However, being pictorial, their usage will always be restricted due to major shortcomings in a picture's ability to express meaning. Pictograms of the future will be very similar to those of today – a blend of iconic images and symbolic images designed to get a clear message across. Pictograms will continue to mainly consist of iconic imagery, as pictures of actual objects do not require previous knowledge to the same extent as symbolic imagery.

Computer interface icons have developed with the growth of information technology and will persist in being central to human-machine communication. People of today interact with an increasingly wide variety of information systems involving the use of icons, and this trend should see people of the future knowing a considerable number of symbols very well. Icons may be efficient due to their pictorial quality being less of a burden upon cognitive processing, and for practical reasons as they take up less space than writing. Icons are like words in that some survive, and others do not. The ones that outlast the others are usually simple, easy to understand, and have a logical consistency with their referent. Just like words, icons must be accepted by their users to be successful, and some icons will continue to be used for generations. However, icons in themselves will never become a true language, as unlike written text, they do not match a set of symbols with sounds. Icons require a limited, contextual field in which to operate, whereas language uses a finite number of symbols to create an infinite number of messages, making the written word incredibly versatile in comparison. Icons nonetheless will continue to play a highly significant role in human-machine interaction well into the foreseeable future, as new operational environments for computer interfaces continue to be created and developed for use in people's daily lives.

Figures

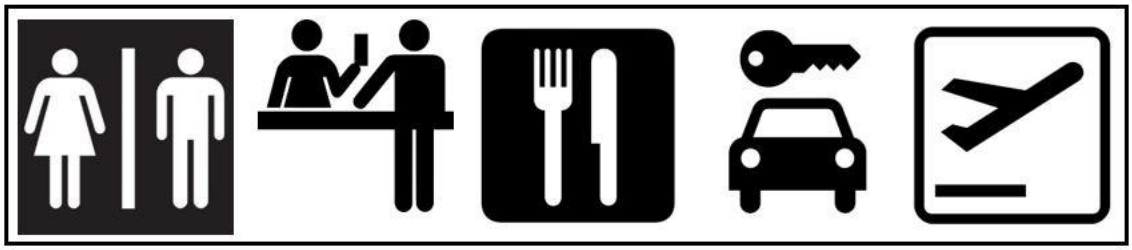

Figure 1. Modern airport signs for toilets, immigration, restaurants, car rental and departures. Images open source or used under Creative Commons licensing.

Figure 2. (From left to right) Australian signs for *no swimming* and *danger crocodiles*. Biohazard logo, biohazard warning sign. Images open source or used under Creative Commons licensing.

Figure 3. The standard radiation warning symbol (left) and the revised radiation warning symbol (right) designed by The International Atomic Energy Agency. Images open source.

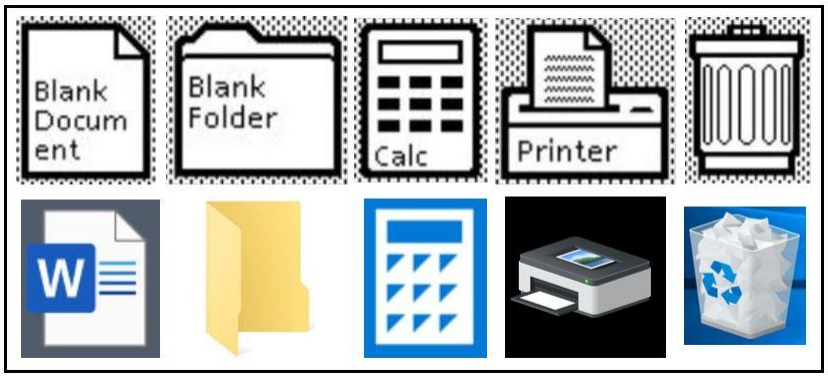

Figure 4. Icons designed for the Xerox Alto (top) and their modern Microsoft Windows 10 counterparts (bottom). Images used for educational purposes only.

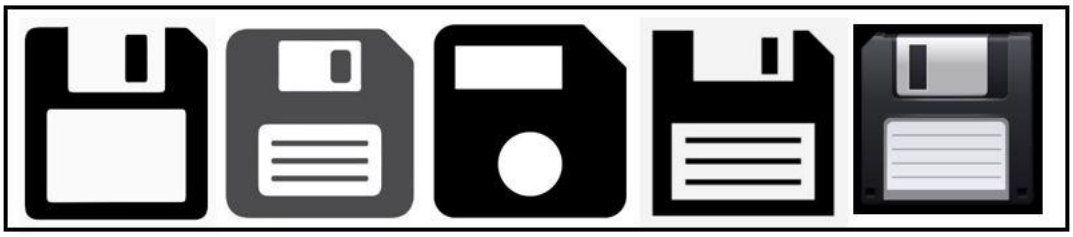

Figure 5. Various generic forms of the save icon, based upon the 3.5-inch floppy disc. Images open source or used under Creative Commons licensing.

Figure 6. Pictorial writing. Above: Gros's icon language which reads "I love dad's cats". Adapted from Abdullah and Hubner (2006), p. 233. Below: Extract from Emoji Dick (p. 19) which reads "But even this wears off in time". Edited and Compiled by Benenson, F. (2010). Creative Commons license.

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