

Why Unity? A Systematic Language Solution

The challenge of providing communication solutions for non-speaking individuals who need Speech Generating Devices (SGDs) can be broken down into two fundamental elements: hardware and language representation system. Hardware can come in many forms, from off-the-shelf consumer tablets to dedicated devices designed from the ground up to meet the specific needs of the non-speaking population. In the case of the former, consumer devices regularly need to be adapted in order to meet the physical needs of clients, such as adding amplifiers, switch interfaces, hardened cases etc., whereas the latter often include many adaptations that are needed to compensate for limitations, such as switch ports, longer life batteries, robust case design, toughened screens, and so on.

But hardware alone does not determine the appropriateness of an SGD. The more important element is the language representation system – the user-facing interface with which a client interacts in order to communicate with other people.

1. Designed on Linguistic Principles

The structure of the Unity representation system mimics how vocabulary and language is stored in the brain. The system codes words based on parts-of-speech along with overt marking of word endings (morphology) to allow clients to generate vocabulary on a keyboard in the same way a speaking individual would generate words by adding endings (e.g. adding *-ing* to *eat* to say *eating*, or adding *-ly* to *happy* to say *happily*). Many other language programs do not offer this but being able to handle words in this way is important for becoming more communicative (Binger, 2008; Kent-Walsh, Binger, Ewing, Hickman, & Quevedo, 2008; Kulkarni, Pring, & Ebbels, 2014), improving vocabulary (Bowers, Kirby, & Deacon, 2010; Gibson & Wolter, 2015; Sparks & Deacon, 2013) and developing literacy skills (Apel & Lawrence, 2011; McCutchen, Green, & Abbott, 2008; Pacheco & Goodwin, 2013)

2. Research-based Core Vocabulary

Unity was released in 1995 and an integral part of the development was to include core vocabulary, which are "...those whose high frequency of occurrence or universal utility necessitates inclusions in most individual vocabulary lists." (Yorkston, Dowden, Honsinger, Marriner, & Smith, 1988). The Unity system includes peer-reviewed vocabulary sets from various groups, which includes toddlers (Banajee, DiCarlo, & Buras Stricklin, 2003), school-age children (Boenisch & Soto, 2015; Wood, Appleget, & Hart, 2016), and adults (Balandin & Iacono, 1999; Beukelman, Yorkston, Poblete, & Naranjo, 1984; Brezina & Gablasova, 2013; Davies, 2009)

3. Icon and Location Consistency

The core set of icons used to access the vocabulary in the Unity program has remained essentially the same since 1995 so as to provide a *consistent* interface regardless of the hardware used. The same icons are also used across different keyboard sizes (36-, 45-, 60-, 84-, and 144-key options) so as to facilitate, where necessary, transition from one to the other as motor and/or visual skills change with age. Two important factors in being able to learn and memorize an interface are consistency (Han, Yun, Kwahk, & Hong, 2001; Wickens, 1984) and familiarity (Isherwood, McDougall, & Curry, 2007; McDougall, Curry, & de Bruijn, 1999), both of which are targeted by Unity's fixed core icon set.

4. Motor Consistency

The sequence of icons used to represent each separate word is constant; it does not change on different pages as other systems do. Maintaining a consistent motor plan for vocabulary provides the opportunity to individuals to become automatic with their selections (Iverson, 2010; Whitmore, Ronski, & Sevcik, 2014), in the same way that the consistent QWERTY arrangement on a keyboard allows for people to touch type, or the consistent arrangement of keys on a piano allows people to play without having to refer to a musical score.

5. Word Prediction

The Unity symbol-based language system does not require any literacy skills in order to be used. However, for client's who are developing their ability to spell, the system includes word prediction and a unique form of word prediction called "morphological prediction" that effectively increases the total number of different words that are predicted at any one time¹. Although using word prediction is typically slower than actually typing out words letter by letter c.f. (Koester & Levine, 1996; Pouplin, Robertson, Antoine, Blanchet, Kahloun, Volle, Bouteille, Lofaso, & Bensmail, 2014), it can reduce the number of keystrokes, which some clients find useful (Anson, Moist, Przywara, Wells, Saylor, & Maxime, 2006).

6. Vocabulary Builder

Unity includes a unique tool to help teach the vocabulary stored on the device. Rather than have all 6,000 words of Unity available at once, it's possible to set the device to show only a small subset of target words. So if a client is being taught just 15 high frequency words, when the Vocabulary Builder tool is turned on, those are the only words and icons available on the device. In this way, learning the system becomes easier because it can take place in small, focused chunks. The Vocabulary Builder tool includes pre-stored lists of evidence-based vocabulary sets ranging from core words used by toddlers (Banajee, et al., 2003) through to words used by seniors over 65-years (Stuart, Beukelman, & King, 1997; Stuart, Vanderhoof, & Beukelman, 1993), and words used in the development of literacy (Clendon, Sturm, & Cali, 2013; Dolch, 1927). These lists can be turned on or off depending on the needs to the specific client.

7. Icon Tutor/Word Finder

Many AAC systems contain large vocabulary sets across multiple pages but have no way for an individual to find specific words. PRC's patented Icon Tutor/Word Finder software tool (Bruce R. Baker, Butler, Cross, Kovacs, Halloran, Halloran, Hershberger, & Read, 2015) allows an individual to type a word and then see the sequence of keys needed to access it. This makes it easier to learn how to navigate through the system, which is an important skill required for success with an AAC device (Robillard, Mayer-Crittenden, Roy-Charland, Minor-Corriveau, & Bélanger, 2013).

8. Icon Prediction

PRC devices use a unique patented feature called Icon Prediction (Bruce R. Baker, Yoder, Hershberger, Romich, Nyberg, & Conti, 1999), which makes it easier for individuals to find words on a keyboard. When a key is selected, only keys that can lead to locations where words are stored are shown. This cuts down to number of buttons that an individual has to choose from and thus simplifies selection. The feature has been available for many years and has been adapted to work with new touchscreen technologies.

9. Predictive Selection

When selecting keys on PRC devices, it is possible to make deactivate all non-used buttons, which in turn cuts down on accidental key hits by people with access issues. The patented Predictive Selection feature (Bruce R. Baker, Hershberger, Gasser, Kushler, & Romich, 1992) works with all methods of access (direct selection, switches, head-pointing, eye-gaze) and also serves to speed up switch scanning as non-active buttons are ignored and the scan pattern skips ahead.

10. Autospell

When selecting keys that include both a letter and an image, the system will automatically switch to spelling mode when it detects that someone is trying to use a sequence of letters rather than a sequence of pictures. This eliminates the need to use a separate "go to spelling" key and cuts down on keystrokes. This is an *exclusive* patented feature of PRC devices ((B.R. Baker, Conti, Hershberger, Spaeth, Higginbotham, & Kushler, 1993).

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ⁱ As an example, selecting the letter "L" | Unity displays the distinct words *last, like, live, long, lock, lunch*, which are clearly all different words. Choosing like puts the word on the screen but also shows the new options of *liked, likes, liking, likely*, and *likeness*. Notice that all these are forms of the word like. In contrast, with a standard word prediction system, selecting the "L" would bring up a mixture of distinct words and word forms e.g. *last, lasting, like, likes, liked*. As you can see, Unity's morphological prediction means that there are more choices of distinct words for a client rather than multiple forms of the same word.