User-centered Design: Wave of the Future
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Abstract
The population is aging. The aging market segment is more than just increasing in number. They are changing. The “new old” have more money, are more educated and are more likely to complain about poor designs. The boomers are a generation that rallied for civil rights, women’s rights, the resignation of a president and the end of a war. They are accustomed to speaking out and to evoking a response. Astute companies will understand the ramifications of this demographic tidal wave, and begin to consider consumers with diverse ranges of ability through a process called universal design. This presentation will:

- provide a background of the concepts of Universal Design
- introduce the seven principles of Universal Design
- illustrate the concepts and principles of Universal Design with commercially available packages
The Aging Market

The population of the “developed” world is aging (Figure 1), and a voice that aging consumers of yesteryear were never afforded. The American Association of Retired Persons (AARP) report entitled “Beyond 50” (2004) indicates, “In the future the word, ‘consumer,’ increasingly come to mean ‘older consumer’.” The same document indicates, “Older consumers are a powerful economic force in America, spending more as a group than all other consumers.” (AARP, 2004) In 2003, older consumers spent $2.6 trillion of the total consumer spending ($4.7 trillion) in the United States. This 55 percent market share was up from 47 percent in 1984 and 52 percent in 2001. The boomer generation, a cohort born between 1946 and 1964, and consumers aged and older contributed to these increasing numbers. (Figure 3) (U.S. Bureau of Labor Statistics, 2005).

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1 The AARP Report chose to define “older consumer” as aged 45 and older in order to encompass the leading edge of the boomer cohort and a portion of the trailing edge. “Boomers” were born between 1946 and 1964.
Residential U.S. Population by Age and Percentage

Source of Figures: National Estimates Program, U.S. Census Bureau

Figure 2 - The Aging of the U.S. Population by Gender
Figure 3- Aging and Total Market Share

Figure 4 - U.S. Life expectancy throughout history by gender source: Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System.
Aging and Disability
Increasing life expectancies have led to the greater number of aging consumers. “Life expectancy is a summary of the overall health of a population. It represents the average number of years of life remaining to a person at a given age if death rates were to remain constant. In the United States, improvements in health have resulted in increased life expectancy (see Figure 4) and contributed to the growth of the older population (Figures 1 and 2) over the past century.” (Federal Interagency Forum on Aging, 2004)

The increases in longevity, however, are accompanied by many challenges; among them are chronic disease and disability (see Figure 5). Government reports frequently quantify and characterize disability by examining the difficulties that a consumer has with activities of daily living (ADLs) and instrumental activities of daily living. “ADLs include bathing, dressing, eating and getting around the house. IADLs include preparing meals, shopping, managing money, using the telephone, doing housework and taking medication.” (Health United States, 2002) Packaging has the potential to be a significant factor for IADLs.

In 2002, more than 4.5 million seniors (14.2%) indicated that they had difficult carrying out ADLs and 6.9 million (21.6%) reported difficulties with IADLs. This is in striking contrast to the younger population (aged 25-64); only 2.8% of that population indicated difficulty with ADLs and 4.0% indicated difficulties with IADLs.

Increasing age correlates with increasing levels of disability (see Figure 5). “Almost three-fours (73.6%) of those aged 80+ report at least one disability. Over half (57.7%) of those aged 80+ had one or more severe disabilities and 34.9% of the 80+ population reported needing assistance as a result of disability.” (Health United States, 2002)

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**Estimated Level of Disability- By Age**

![Estimated Level of Disability- By Age](image)

Universal Design Principles and Design Guidelines

As a result of the aforementioned trends, package designers are beginning to show interest in what’s known as Universal Design (UD). American architect and designer Ron Mace first coined the term in 1985. Mace defined the concept as “the design of all products and environments to be usable by people to the greatest extent possible without the need for adaptation or specialized design.” Products that are designed universally reach the largest possible audience by going beyond the needs and abilities of “average, healthy” adults to include seniors, children, and those with motor and sensory disabilities.

The movement has evolved in the 20 years since Mace coined the phrase and has achieved considerable recognition. The ideas have been widely applied in architecture, product design, and web design, but they have yet to be applied widely to packaging in the United States.

Package designs that are created using the UD philosophy incorporate users of wide ranging abilities, habits, approaches and needs to provide insight during the design process. The UD philosophy, created by Ron Mace and refined into seven principles (see Figure 6) by an interdisciplinary team of researchers and designers, strives to achieve total inclusiveness; packages and products that can be used successfully and easily by all users, “universal designs.”

**Is my package flexible enough?**

*Principle one: “Equitable Use”*

<table>
<thead>
<tr>
<th>Design Guidelines:</th>
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<tbody>
<tr>
<td>• Provide the same means of use for all users: identical whenever possible; equivalent when not</td>
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<tr>
<td>• Avoid segregating or stigmatizing any consumers</td>
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<tr>
<td>• Make provisions for privacy, security and safety equally available to all consumers</td>
</tr>
<tr>
<td>• Make the design appealing to all consumers</td>
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This principle aims to ensure that a variety of consumers can use the package, regardless of differences in their ability, behaviors, habits or size.

This principle also addresses the issue of feeling segregated or stigmatized because of differences in personal abilities. The ideal design is universal for all users; there is not a “special” design for those with different needs or abilities. One important note here is that the ideal design is a final goal, not a reality. It is unlikely, if not impossible, that manufacturers will ever be able to accommodate ALL users with a single

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2 The Principles themselves were compiled by the following advocates of universal design. Alphabetical order: Bettye Rose Connell, Mike Jones, Ron Mace, Jim Mueller, Abir Mullick, Elaine Ostroff, Jon Sanford, Ed Steinfeld, Molly Story, & Gregg Vanderheiden
design. However, by considering a broad range of users’ abilities during the design process, products come closer to the ideal design and easier for everyone to use.

Principle one also concerns issues of privacy, security and safety. Regardless of the users personal capabilities, the package and product should deliver the same degree of service to each user. One example of packaging that is currently NOT abiding by this ideal is child resistant packaging. People with severe arthritis or other physical limitations that cannot use child resistant (CR) packaging are forced to use non-CR platforms, even if they have children present in their homes. Manufacturers are recognizing this inequity, and beginning to use resources to develop innovative, and inclusionary, CR systems that serve consumers with a broader range of abilities than traditional designs.

Every user is unique

Principle two: “Flexibility in Use”

<table>
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<th>Design Guidelines:</th>
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<tr>
<td>• Provide choice in methods of use</td>
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<tr>
<td>• Accommodate right or left handed access and use</td>
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<tr>
<td>• Facilitate consumer’s accuracy and precision</td>
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<tr>
<td>• Adapt to the consumer’s pace</td>
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Every potential consumer should be able to find at least one, safe way to use your package effectively. This is despite the fact that some are right handed, others left, some will comply with your instructions, others will not; all will work at different paces.

User trialing of products and packages has shown that actual use usually differs from the assumed use (Kanis, 1998). Ethnographic testing reveals that consumers perform a variety of unanticipated actions while using packages and the products they contain.

For packaging, unanticipated actions typically involve physical manipulation of the package. Examples of tasks that can be performed in unanticipated ways include: opening, closing, storing, pouring, transporting, gripping, lifting, holding, etc. By design, or desperation, many users resort to the use of tools (both appropriate and inappropriate) to perform a given task. This is not without consequence. In 2001, (the most recent statistics available) the U.S. federal government attributed 303,871 emergency room visits to household packaging and containers. That’s more culpability than was attributed to saws, hammers, skateboards or playground equipment for the same year!

The good news is that the variation of unanticipated user actions is not infinite. Research, especially observational methods, tells manufacturers which actions are the most typical. Good structural design eliminates package characteristics that lead to unwanted actions and considers the diversity of user actions in order to influence consumer behavior.

Principle two also encourages designs that facilitate a consumer’s accuracy and precision. A redesign of Duracell hearing aid battery packaging, a joint undertaking between Product Ventures and Duracell, provides an excellent illustration of this idea.

The original package design contained the product, a very small hearing aid, and was comparable to all competitors’ packaging designs. However, research showed that it was so difficult for consumers to place a battery into the hearing aid correctly, and that many elected to wait for help with battery changes and frequently saved their hearing aids for “special occasions.” It quickly became evident to the team that a design innovation was needed.
The solution came in the form of a package change, the Duracell EasyTab. As part of the package redesign, a paperboard laminate now serves as a tool for placing the battery into the hearing aid, enhancing the accuracy and precision of user movements, and eliminating the likelihood that the user will place the battery into the device “upside down.” According to Peter Clarke, president and founder of Product Ventures, the package “empowered end users, for the first time, to change their hearing aid batteries, by themselves, without struggling. By enabling the end user, Duracell was able to sell more batteries. More important, the end user could depend on having charged hearing aids all the time.”

Designing for intuition and simplicity

<table>
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<tr>
<th>Principle three: “Simple and Intuitive Use”</th>
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<tbody>
<tr>
<td><strong>Design Guidelines:</strong></td>
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<tr>
<td>• Eliminate unnecessary complexity</td>
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<tr>
<td>• Foster consistency with user expectations and intuition</td>
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<tr>
<td>• Accommodate a wide range of literacy and language skills</td>
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<tr>
<td>• Arrange information consistent with its importance</td>
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<tr>
<td>• Provide effective prompting and feedback during and after use</td>
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This principle examines the package to determine whether or not its use is as simple and straightforward as it can be. An untrained person should be readily able to effectively navigate the design and gain an immediate understanding of the product. In sum, use of the package design is easy to understand, regardless of the user’s level of experience, knowledge, language skills, or current concentration level.

Packages not only communicate information through a complex combination of visual elements such as color scheme, shape, configuration, text and graphics, but also do so by using non-visual elements such as sound, odor, and texture. Exciting new developments are currently taking place that explore the non-visual aspects of package design. Companies, such as Flint Ink and Sud-Chemie chemicals have introduced scented packaging, which can reinforce the flavor of a product, or the essence of a brand through the consumer’s olfactory system.

Packaging designs can engage consumers on many levels; through hearing, sight, touch, smell or taste. Regardless of how a package is attempting to communicate, the most important features of the package should be the most obvious. Good design will consider the importance of the message being communicated and explore how best to send the consumer that message clearly and effectively.
Am I clear?

Principle four: “Perceptible Information”

Design Guidelines
- Use different modes (symbol, text, tactile etc.) for redundant presentation of essential information
- Maximize legibility of essential information
- Differentiate elements in ways that can be described
- Provide compatibility with a variety of techniques or devices

As mentioned previously, clearly communicating, or ensuring that the most important message is perceptible, is very important. Designing intuitive packaging (as described in Principle three) has its limitations; only so much information can be conveyed intuitively. Packages still need to communicate information overtly. While principle three is mainly related with the first few seconds of the user-package interaction, principle four concerns how to efficiently convey specific, less-obvious information about the package and its contents (directions, warnings, etc.). This is typically, but not necessarily, done through the use of visual messages.

Three things determine the success, or failure, of a visual message: the user, the environment in which the interaction occurs, and the package itself. Product manufacturers have little to no control over the user, or the environment of interaction, but they can control the package. Package designers should consider consumers with limited sight, the possibility of less-than optimal environments for interaction, and users that do not read English as they design overt information. Redundancies of information presentation (such as text and symbol, text and Braille or designed intuition and text) provide multiple ways for the consumer to effectively navigate the design and increase the likelihood that the information will be encountered and understood.

Packages that poorly execute this principle include designs with exceedingly small print, cluttered labels, poor contrast, etc. This poor execution is not necessarily limited to printed labels; it can involve structural elements of the package, as well. Consider the snap cap, child resistant closure that requires a consumer to line up two arrows, one on the cap and a second on the bottle, and push. Even though the arrows are generally embossed, if they are not of sufficient contrast, it can be difficult for many consumers (particularly the elderly, who have diminished contrast sensitivity) to see them. This information is not sufficiently perceptible.

My mistake

Principle five: “Tolerance for error”

Design Guidelines:
- Arrange elements to minimize hazards and errors
- Provide warnings of hazards and errors
- Provide fail-safe features
- Discourage unconscious action in tasks that require vigilance

People make mistakes when using things, packages are not exceptions. Since we cannot prevent all these behaviors, package designs should “tolerate” them, without causing damage to the product or injury to the consumer. The Duracell case study, presented previously as part of Principle two, demonstrates how good package design provides a fail-safe feature that alleviates user error. As mentioned, when using the preceding generation of design, many of the users placed the battery into the hearing aid “upside down.” The addition of a simple paperboard handle to the battery allowed the user to use a tool, ensuring the battery was accurately, and correctly, placed into the device each and every time.

It is not always possible to avoid all hazards and errors through good design. For instance, there are certain, inherent risks associated with the incorrect use of over-the-counter drugs. Certain drugs cannot be taken with specific foods, other drugs, or when a consumer has been diagnosed with a given condition. The package must contain warnings that indicate these hazards. Good design (or, in the case of drugs, compliant design) will consider the possibility of error, and appropriately warn the consumer. These warnings will be perceptible (principle four), and the importance of the information (principle three) will be high; as a result, much thought and effort will go into designing this information so that the user is likely to encounter, understand and comply with the message.
Don’t make me work

Principle six: “Low Physical Effort”

Design Guidelines:
• Allow user to maintain a neutral body position
• Use reasonable operating forces
• Minimize repetitive actions
• Minimize sustained physical effort

Ideally, packages should work well when consumers exert minimal physical effort; designs should consider users who may be weak, tired, or weakened from medical conditions. This is becoming a significant issue as the population ages. The number one cause of disability in the U.S. is arthritis, and the prevalence of arthritis increases with advancing age (see Figure 7). Patients with arthritis in the hands experience fluctuating levels of joint pain, lack overall strength, weakened grip, limited pinch strength, diminished manual dexterity and the inability to squeeze and press. All of these factors have the potential to impact a consumer’s ability to effectively use packages.

In addition to considering the forces that a consumer must exert to effectively manipulate your packaging design, you must also consider their biomechanics. Designs should be used comfortably, without awkward movements or postures. Any design that produces repeating motion that may cause fatigue or pain should be avoided. If the user has to rest after using a product there is problem as well.

Size, and shape, matters

Principle seven: “Size and Space for Approach and Use”

Design Guidelines:
• Provide a clear line of sight to important elements for any seated or standing user
• Make reach to all components comfortable for any seated or standing user
• Accommodate variations in hand and grip size
• Provide adequate space for the use of assistive device or personal assistance

![Percentage of adults with doctor-diagnosed arthritis](image)

**Source:**
National Health Interview System, United States, 2002
www.cdc.gov/mmwr/preview/mmwrhtml

Figure 7 – Percentage of adults with doctor-diagnosed Arthritis
The shape and size of a package, or its parts, have profound consequences on a product’s usability. Appropriate size and space should be provided for approach, reach, manipulation, and use regardless of user’s body size, posture or mobility. For instance, the handle of a container should accommodate users with a wide range of hand sizes (usually between percentiles 5% to 95%). The principle strongly relates to anthropometric characteristics, the size and shape of the human body. Additional considerations are necessary, for example, if the user will use the package with gloves, construction workers, mechanics, the size and space required to use the product comfortably will be completely different.

An example of this principle in action is the redesign of the I-Glide Wheel Chair cases, a joint venture between Anchor Bay Packaging, Independence Technologies and Ethicon Endo Surgery.

Prior to the redesign, the existing cases measured 36”x28”x33.5”. These dimensions proved challenging to load at the manufacturing facility (see Figure 8) and to unload, particularly because the end consumer was likely a wheel chair user. In addition to the poor approach for size and space of the existing design, accessories (battery, cushions and rails) had to be shipped in a separate shipper, adding shipping costs for the manufacturer and inconvenience for the end consumer.

To address the aforementioned issues, the shipper was redesigned to a telescoping case that measured 27”x27”x33.5”; the telescoping top was secured to a 4” tray with Corru-Clips® (see Figure 9) and accommodated all accessories in a single package. The new design realized improved efficiencies not only with the end consumer, but in cube out, material usage, shipping costs and assembly.

**Conclusions**

Designs that consider all users during the process, as steered by the 7 Principles of Universal Design and their guiding principles present a real opportunity for the paperboard packaging industry as the population ages.
Bibliography


National Health Interview System of the Centers for Disease Control. (2002). Available online at www.cdc.gov/mmwr/preview/mmwr.html
User-Centered Design
Wave of the Future

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Agenda
• Trends in the population
  • Aging
  • Disability
• History - Universal Design
• What is Universal Design?
• Principles of Universal Design
  • Paper and paperboard examples
  • Testing for Inclusion Principles

Trends - Aging

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<tr>
<th>Country</th>
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<tbody>
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<td>10</td>
<td>67</td>
</tr>
<tr>
<td>USA</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>UK</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Germany</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Japan</td>
<td>87</td>
<td>87</td>
</tr>
</tbody>
</table>

Note: Data for 21-65 years old. Reference population: 'Population of the United Nations.'
Trends - Disability

So what?
What is Universal Design?
The design of products and environments to be usable by ALL people, to the greatest extent possible without the need for adaptation or specialized design.

Ron Mace

The Seven Principles of Universal Design

1. **EQUITABLE USE**
The design is useful and marketable to people with diverse abilities.

2. **FLEXIBILITY IN USE**
The design accommodates a wide range of individual preferences and abilities.

3. **SIMPLE AND INTUITIVE**
Use of the design is easy to understand, regardless of the user’s experience, knowledge, language skills, or current concentration level.

4. **PERCEPTIBLE INFORMATION**
The design communicates necessary information effectively to the user, regardless of ambient conditions or the user’s sensory abilities.

5. **TOLERANCE FOR ERROR**
The design minimizes hazards and the adverse consequences of accidental or unintended actions.

6. **LOW PHYSICAL EFFORT**
The design can be used efficiently and comfortably and with a minimum of fatigue.

7. **SIZE AND SPACE FOR APPROACH AND USE**
Appropriate size and space is provided for approach, reach, manipulation, and use regardless of the user’s body size, posture or mobility.

Principles 1 and 2

1. **Equitable Use**
   - All users
   - Identical where possible, equivalent where not

2. **Flexibility in use**
   - Use actually usually differs from assumed use
   - Good structural design eliminates unwanted actions and considers diversity
Principles 3 and 4

3. Design for simple and intuitive use
   - An untrained person should be able to effectively navigate the design and gain an immediate understanding of the product

4. Perceptible Information
   - Maximize legibility
   - Redundant cues for necessary information

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Principles 5 and 6

5. Tolerance for error
   - Arrange to minimize hazards and error
   - Provide fail-safe features

6. Low Physical Effort
   - Reasonable operating forces
   - Minimize sustained effort or repetitive actions

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In an attempt to try to reduce the variability of data, Dr. Lockhart directed the production of second machine (See Photo 2) in 1999.

- Notice
- Decode
- Comprehend
- Comply
  - Rousseau (1998)
Principle 7

- Size and Shape for Approach and Use
  - Accommodate variations in size (grips/handles)
  - Clear line of sight

In Conclusion

- The population is aging
- With increased age, come increased disability
- It is no longer enough to consider the “able bodied” user as our design target
- Employing the 7 principles of Universal Design to our package design process is the right thing to do, and makes good financial sense

Thank You

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Please remember to turn in your evaluation sheet...