Instrument Design Is A Touchy Subject

Tactile experiences have played a role in how we evaluate products since the early phases of man's evolution. It's especially important in surgery, where an instrument's tactile properties are essential the surgeon's ability to use it comfortably and safely …

March 10, 2010

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Designing for touch goes hand in hand with overall industrial design process

Every product creates a sensory experience for the user.

We are constantly asking ourselves—consciously or subconsciously—is the product pleasing to look at, does it perform its prescribed task well. We usually ask ourselves another question: How does it feel?

Everyone has encountered products that simply feel wonderful to hold and use. And we've all touched products that have felt just plain wrong, even if they performed reasonably well. Everything else being equal, the sense of touch can determine the success of a product.

Tactile experiences have played a role in how we evaluate products since the early phases of man's evolution. In primitive times, the role that touch played in products was, in a word, primitive.

Early human beings who first created axes out of a stone lashed to a tree branch didn’t concern themselves much with the finer points of touch. They only cared that the stone stayed lashed to the branch and that they could get the mass moving with enough force in the right direction.

Over time, the role that touch played in products progressed dramatically. For every product created today by a formal industrial design process, tactile properties play some role in how well it performs, in the emotional response of the user, and in the overall brand experience.

The dominance of tactile properties in overall product performance varies widely, however. The sense of feel for one product may not rise to a conscious level for the user or it may dominate and define the overall experience.

A computer mouse, for example, provides a tactile experience that ties perfectly into the sensory world of using a computer. The tactile properties are critical, but are not uppermost on the mind of the user. By contrast, using the pull tab on an aluminum soda can continues to be disagreeable experience.

Like anything in industrial design, integrating a positive tactile component into a product will suffer when it’s approached in a haphazard way. At Tanaka Kapec Design Group (TKDG), we have been incorporating a structured approach to

optimizing tactile properties into the designs we present to clients for more than 30 years. It’s integral to everything we do.

Before explaining how we design for the sense of touch, it’s worth describing what we view as the factors contributing to the tactile sensation of a product.

How it feels to the hand or other part of the body. This is the most obvious consideration. It’s influenced by a combination of shape, size and texture. For example, the pistol grip on a water spray device should be sized and shaped to conform to the shape of the hand. A much different shape and size is called for in designing an ice scraper, cell phone, or in the controls for a backhoe.

Vibrations & Other Movements

For some products, vibrations and other movements are part of the feedback. The vibration you feel when a golf club makes contact with the ball contributes positively or negatively to the overall experience. No doubt it’s less important than if the ball dribbles off the tee or slices into the rough, but it’s important feedback nonetheless. In using a monkey wrench, a plumber or pipe fitter gets feedback on the progress being made in loosening or tightening a pipe by the vibrations felt.

Weight & Pressure

The heft of some products is fundamental to their function. This doesn’t just apply to sledge hammers. It can more subtle than that. There is a blanket on the market that incorporates weight into the overall functionality. It’s designed to be used in calming hyper-active children by applying soothing pressure. You can see it at: http://craftnectar.com/2009/09/03/calming-the-senses-with-weighted-blankets/.

Who will use it? How will it be used? Will it be used exclusively by males, females, teenagers, babies, the elderly, dogs, cats or some combination of these?

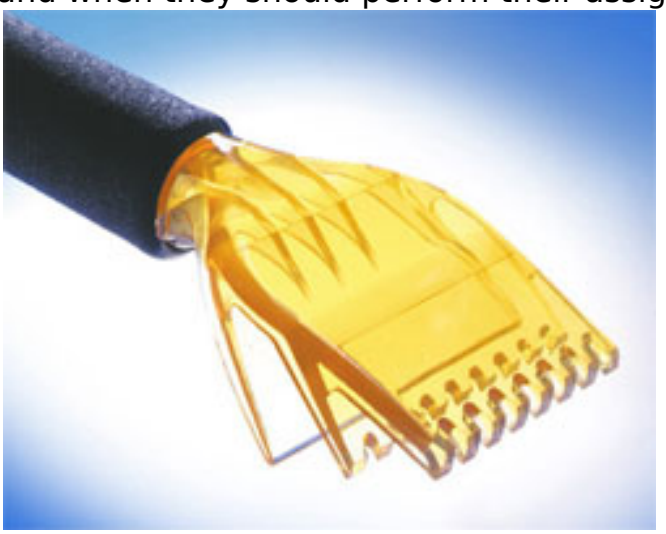
It’s important to understand the physical differences of users as well as their intellectual capabilities and temperament. For example, the knobs on a car’s dashboard generally need to be proportioned for both genders and that imposes constraints on how they feel to two very different types of hands.

Range of motion is another important factor. The range of motion and relevance of gross motor skills vary greatly between certain professionals and the products they use. Designing a product for a framing carpenter and a neurosurgeon presents significantly different tactile requirements.

In fact, there are even major differences in the range of motion and gross motor skills required for different types of surgeons. An orthopedic surgeon who is trying to force a new artificial hip into place is engaged in a physical process that lies somewhere on the continuum between framing carpentry and brain surgery.

How do the tactile properties interact with other senses? The tactile feedback loop is informed by sight, smell, and sound. The tactile feedback you get by pulling the chord to start a lawn mover is woven into the scent of oil and gas and sounds produced to form an overall experience.

You can tell by the feel—and the smell and the sounds—whether or not it started. On another level, light feedback can be integrated into the sense of touch for a product. In training a surgical team, light feedback can be used to help the surgeon develop a steadier hand and to inform the rest of the operating room team in how and when they should perform their assigned task.



The Nintendo Wii remote is yet another good example of using sensors and tactile feedback as well as visual and sound clues to let the user understand exactly how their movements are affecting their game. Over time, the player learns to use these combined cues to develop a more precise set of hand-eye coordination techniques.

Of course, this is only a sampling of the tactile characteristics that industrial designers need to consider. AT TKDG, the tactile considerations we assess and how they are integrated into our overall industrial design process have evolved over the past 30 years.

The sophistication of our processes has progressed as the science and industrial design knowledge has progressed and as we have gained experience.

Key Steps When Incorporating Tactile Considerations

Here are the key steps in our design process and how we incorporate tactile considerations into our user research and product development:

First, we collect information from users in the environment where the product will be used. For every product we develop, one of our first steps is to observe users in action by studying all aspects of their environment—what interacts with the product, temperatures, sunlight and artificial lighting.

We also consider other factors like how the product will be shipped. The same principles and practices apply whether we are designing a new device for use in surgery or a simple consumer product.

We observe the users in action on a predecessor device to gauge the scale of motion, the degree of precision required, the postures they use, the repetition required and the likelihood that some people will use the product in unexpected ways.

We determine if the task is gender specific or not. We also analyze the role played by auditory feedback, sightlines, visibility, lighting and the placement of the business end of the product. Are there pressure points on the hand or other part of the body that must be considered? Are there sensual or aesthetic expectations at play?

The information that emerges from this activity forms the baseline for gathering and analyzing more detailed behavior information. We go back into the field to observe more users, but this time we view the user as we think a 10-year-old might—without any preconceptions about what is going to take place or how a device should be used.

Freeing our mind to be receptive to every possibility is absolutely essential. Were we to approach this phase with rigid preconceptions we might miss a breakthrough in the tactile experience as well as in other product experiences.

We pay special attention to body language and facial expression of the user. In many projects, it’s easy to see from facial expressions and other physical reactions.

What steps in the process work well with the existing design and which don't.

We've seen a wide range of facial expressions and reactions, including a surgeon who was so frustrated by the predecessor device we were charged with replacing that he flung it across the operating room. (This particular surgery had a good outcome and the patient was oblivious to the incident.)

This detailed, analytical observation of individual users is repeated until we fully understand how the product should operate in the context where it will be used. The number of individuals observed will vary, depending on the complexity of the product and the range of environments in which it will be used.

The observations typically reveal issues that must be dealt with and opportunities that can be exploited. The observations are used to define the scale of the tactile feedback and how it provides functional value or contributes to the sensory experience. For each product, there is a right and wrong scale of movement. What is right for microsurgery is not right for digging a hole in the ground.

The next step is to incorporate what we've learned about the desired tactile and other properties into the creation of several physical concept models, made from clay, wood or other materials.

The physical concept models, which typically include the expected form factors and some off-the-wall executions, help us explore our hypotheses. We put just enough finish on them to focus the experience on the relevant tactile event.

It's now back to the user. We introduce the concept models into the end-user's environment so they can view, touch, hold and manipulate them. We again observe the user's behavior to collect more feedback.

This information, along with all other feedback, is distilled into three or more basic directions we can take. A new set of physical models is created, this time with more refined proportions, features and materials.

We go back to the user to get more feedback, once again approaching the observation with as much of an open mind as possible. After observing patterns and collecting verbal and visual feedback, we refine the design as needed and then capture the possibilities in CAD (computer aided design).

After translating our observations from the physical world into the CAD system, we reverse the process and create a formal prototype based on the CAD translation. The prototype is taken back out into the field for trial use and final confirmation.

Get The Sense Of Touch Right

Over the years, there have been dozens of projects that turned out more successful because we took special care to get the sense of touch right in the design.

For example, TKDG was retained by FedEx to design a key board for handheld

devices used by their couriers. During the FedEx project, we had to design a keyboard that would perform well for couriers in several environments.

The courier working in high rise buildings in New York City has a vastly different set of challenges than a courier delivering packages in rural environments. Our job as designers was to develop one design that served diverse tactile requirements.

Working with FedEx, product companies such as Brother International, and a wide range of medical device manufacturers, we have developed a number of unique approaches to understanding the environments where the product will be used and incorporating the sense of touch into the overall product experience.

Along the way, we've received thousands of comments from users that reinforce how important the sense of touch is to the way products are perceived and used.

For example, during one medical device project we were having dinner with one of the finest orthopedic surgeons in the country after spending the day observing him in action. His feedback to us, "I would like to have my surgical instruments feel like the knobs on my Lexus."

That told us how the surgeon—and no doubt users of thousands of other products—relate a fond tactile experience in one part of their lives with what they expect from products in another. It's up to the industrial designer to find out what tactile experience can enhance the real and perceived value of a product.

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From 1980 to the present, Kapec has worked on design and product development programs in the following areas: surgical instruments, medical diagnostic equipment, pharmaceutical packaging, drug delivery systems, technical instruments, office equipment, office furniture design, and consumer products.

He has been awarded more than 38 utility and design national and international patents in advanced technology, surgical instruments, and mechanical design.

Kapec is also a professor of Three Dimensional Design in the Industrial Design Department at Pratt Institute, New York City. He graduated with honors from Pratt Institute, receiving a Bachelor of Industrial Design.

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