Psychology by Design
Too bad the phrase “intelligent design” is already taken (especially because it is neither). It would be the perfect name to capture the exciting collaborations taking place at the intersection of psychological science and design. But coming up with a catchy name is the least of the challenges facing this emerging field. (How does “really really intelligent design” sound?)
Elements of Graph Design

of cognition and perception to visual design — the book

design researchers, but his 1994 effort to apply principles

academic psychology. Edward Tufte has criticized it for relying too heavily on

it as being too removed from the laboratory, design guru

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received by design educators and the public, the book has

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Such criticisms can make applying psychological science
to real-world problems seem like a thankless task. But there
is evidence that, criticisms notwithstanding, psychological
methods, theories, and findings are becoming increasingly
important to design.

Psychology is being taught in design graduate programs
such as that of Chicago’s Institute of Design, while design firms
such as Columbus, Ohio’s Sonic Rim are using psychology
to improve the design process. The fields of human factors,
human–computer interaction, and environmental psychology,
of course, have long brought design and psychology together.
And while design researchers have begun conducting
studies of visual perception under real-world conditions,
psychologists such as APS Fellow and Charter Member
Barbara Tversky, Christopher Wickens, and Daniel Montello
are collaborating with designers on projects that, in some
cases, lead to new products or significant improvements to
existing designs.

**Living in the Material World**

As the practice of design becomes increasingly
professionalized, with its own professional associations,
research journals, and even doctoral programs, design
educators are turning to psychology — and to related fields
such as sociology and anthropology — for sophisticated
research methods and fundamental discoveries about how
people interact with the world of human-made artifacts.

The complexity of today’s design challenges is helping
create what designer Meredith Davis calls an “emerging
research culture” at the intersection of design and the human
sciences. “Designers have had to learn to collaborate with
these fields, become familiar with seminal studies that relate
to projects, and make use of research results in the generation
of design solutions,” said Davis, who teaches courses on
design and cognition at North Carolina State University,
home of a recently established doctoral program in design.

Such doctoral programs are primary sites for new research
cultures to emerge. At the Institute of Design in Chicago,
home to a similar doctoral program, Sharon Poggenpohl
has advised three PhD theses that draw from both perceptual
psychology and communication design. One focused on
the comprehension of multimedia stimuli, another on the
perception of meaningful motion, and the third on gestalt
principles of motion. Although the students’ projects are
colaboration between psychological and design methods,
they focus on problems of primary interest to designers. “The
questions they ask are questions a psychologist is not likely
to be interested in answering, but they are questions whose
answer will serve designers practically,” Poggenpohl said.

Poggenpohl’s students try to use stimuli that resemble
the materials designers encounter in their practice, rather
than the simpler and more abstract stimuli often favored by
experimental psychologists. For example, Peter Storkerson,
who completed his dissertation under Poggenpohl in 2001,
conducted a quantitative study with more than 150 subjects on
the assignment of meaning to randomly-associated audio
and video clips. Storkerson found that there was broad consensus
among participants on which combinations of visual and
verbal information were most easily integrated into a single
meaning. He also found that the most easily integrated pairs
of clips were remembered best, and that subjects were able
to determine whether an audio clip matched the meaning of
a video clip much more quickly when the audio clip was
presented first.

The results of such studies do not always match the
results of experiments conducted by academic psychologists.
“The difficulty of many of these studies in psychology
is that they rarely account for the mediating influence of
context and content,” Davis said. In her design courses, she
asks students to consider how basic psychological studies
might be relevant to what she calls the “complex visual
landscape of the real world.” In some cases, students find that
outcomes that contradict research findings can be achieved
under commonly encountered real-world conditions. Such
demonstrations don’t invalidate research findings, but they
do suggest that such findings need to be complemented by
more applied research.

Davis and her students have focused particularly on
design and psychology in educational contexts such as
museums and schools. One of their projects involves the
development of an interactive version of the periodic table of
the elements that pulses and beeps to indicate reactivity and
other chemical characteristics. Davis said the goal of such
artifacts is to reach students who might not learn well from
traditional teaching methods. The design and testing of such artifacts is informed by David Kolb’s work on learning styles, Eleanor Rosch’s work on prototypes, Mark Johnson and George Lakoff’s writings on schemas, APS Charter Member Jean Mandler’s work on narrative structure, APS Fellow and Charter Member Don Norman’s writings on design, and Kosslyn’s work on mental imagery, among others.

Beyond the universities, design’s turn toward psychology is evident in the private sector as well. The design consulting firm Sonic Rim is one of a number of firms that have begun to employ the methods of behavioral science. Sonic Rim’s president, psychologist Liz Sanders, has suggested that designers need to move beyond the paradigm of “user-centered” design — which still assumes that the object or image is the focus of the design process — toward thinking of designers as partners in the collaborative production of relationships and experiences.

Sanders is not alone in suggesting that psychology and other behavioral sciences are key to design’s future. MIT’s Media Lab, which is largely funded by industry, has long been a center for productive collaborations among psychologists, engineers, computer scientists, and artists. For instance, Justine Cassell, a former Media Lab member who holds a double PhD in psychology and linguistics and who is now at Northwestern University, has used psychological theories and research methods to develop what she calls “embodied conversational agents.” In one ongoing project, Cassell and her collaborators are drawing on work by Barbara Tversky and others to create computer-animated human-like agents that respond to queries about directions using naturalistic speech and hand gestures. Interest in psychology among designers is also being driven by demographic change, such as the aging of the American population. In March 2004, a conference on “Visual Design for an Aging Population” at Washington University in St. Louis brought psychologists together with graphic designers and architects to talk about how designers should take into account the fading visual and mental acuity of older Americans. According to graphic designer Ken Botnick, who organized the conference, perceptual and cognitive psychology has informed the work of designers since at least the early 1950s, but there seems to be increasing interest today in using psychological expertise to help designers better meet the needs of the elderly.

Novel Graphics
While designers are increasingly turning to psychology,
psychologists are also reaching out across disciplinary boundaries to get involved in practical design problems. The historical roots of such interdisciplinary work include human-factors research on aviation during World War II and more recent developments such as the fields of environmental psychology and human–computer interaction that emerged in the 1970s.

In some cases, particularly in the area of perception, psychologists have developed fundamental theories and approaches that can be applied with little change to real-world design problems. Kosslyn, for example, has applied fundamental discoveries of perceptual and cognitive psychology — such as gestalt principles of perceptual organization, limits to cognitive capacity, and mechanisms for directing and holding attention — to graphic design. In a forthcoming book he argues that the use of presentation software such as PowerPoint can be improved with the help of psychological principles. For instance, gestalt principles suggest that conceptually related elements of a slide should be grouped together, while research on cognitive capacity suggest that the amount of information presented in any one slide should be limited.

Many collaborations between psychologists and designers grow out of special circumstances, such as the close links between the Silicon Valley computer industry and Stanford University. Cognitive psychologist Barbara Tversky, who recently moved to Columbia Teachers College after spending most of her career at Stanford, has long bridged the worlds of academic research and design applications. She and her students have studied how people make and understand maps, how diagrams communicate information, and how freehand sketches aid the creative process of architects and designers. Recently she and her students collaborated with computer scientists at Stanford to develop software that automatically generates user-friendly driving maps and instructions for do-it-yourself furniture assembly.

Another example of how favorable circumstances can promote cross-disciplinary work is the Aviation Research Laboratory at University of Illinois at Urbana-Champaign, where Christopher Wickens has been conducting studies to improve aircraft cockpits for the past three decades. Because the University of Illinois hosts a pilot training program, Wickens has ample subjects for his studies. In one recent study, Wickens examined how new three-dimensional displays of the airspace — which are already in use in some corporate jets — affect pilots’ ability to stay on course and detect unexpected hazards. Using simulators, Wickens has found that the “virtual tunnels” – three-dimensional representations of the path along which the plane should fly— made possible by such displays do improve navigation. But because the displays are ambiguous about whether the paths of two aircraft will collide, they can make it harder for pilots to detect and respond to unexpected hazards.

Making a Spatial Effort
Some psychologists have found that effective application

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**Improving Aircraft Safety**

For the past three decades, Chris Wickens has been working to improve the display of visual information in airplane cockpits. As the head of the University of Illinois at Urbana-Champaign’s Aviation Research Laboratory and Human Factors Division, Wickens uses his background in cognitive psychology to design realistic experiments on how new technologies affect the performance of pilots.

Wickens’s research focuses on four main areas: the representation of three-dimensional reality in two-dimensional displays, the use of heads-up displays, the design of instrument panels, and the use of alerts and alarms. His work draws on current psychological research on attention and perception as well as on foundational works such as Richard Gregory’s 1966 classic *Eye and Brain*.

Since World War II, when human-factors research on aviation first began, the federal government has played a central role in translating such research into practice. Government funding supports much of the basic research on which Wickens bases his own work and his applied research is largely funded by the National Aeronautics and Space Administration, with some contributions from private industry.

NASA and the Federal Aviation Administration develop guidelines for cockpit design based on the work of Wickens and others.

The path from basic research to real-world implementation isn’t always smooth, says Wickens, who will retire in January. Research funding is insufficient to keep up with the fast-paced development of new technologies, so the aircraft industry sometimes goes forward with new technologies before relevant research has been conducted.

Overall, however, the area of aviation remains an unparalleled example of the successful application of psychology to design.
of psychology requires full immersion in another discipline. Dan Montello holds a PhD in cognitive psychology but has spent the past 13 years working in the geography department at the University of California, Santa Barbara — the first 5 years of which, he says, effectively constituted a second PhD. That experience has made Montello aware of the difficulty, and the promises, of cross-disciplinary collaboration. The “intellectual and practical purposes” of designers and research psychologist are fundamentally different, he says: one group focuses on creating better designs, while the other focuses on improving the understanding of human behavior.

Despite such fundamental conflicts, Montello believes that further collaboration between psychologists and designers would be useful. In his own work in cognitive geography, Montello has studied how people perceive spatial representations of information, whether the content of that information is spatial in nature or not. In a recent study, he and his colleagues investigated so-called “point-display spatializations,” in which the similarity between two documents is represented by their spatial proximity. They found that the perceived similarity between two points could be affected by factors other than distance, such as clustering: Two points within the same cluster tend to be perceived as more similar than two points in different clusters, even if they are further apart. Such work has at least the potential to affect design practices.

As APS Past President Robert Bjork, University of California, Los Angeles, points out, one of the most valuable things that psychologists have to offer is, in some ways, the most basic: their use of sophisticated research designs to produce reliable insights into human behavior. The gradual permeation of psychological approaches into design suggests that the approaches and findings of research psychology are increasingly seen as essential to design’s future.

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