

The Psychological Robot: A New Tool for Learning

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The growing fascination and popularity of robotics and artificial intelligence (AI) is observed culturally from Hollywood movies to popular magazines, comic books, and even novels. This article describes an innovative assignment created for a General Psychology course at a small pharmacy college. This assignment is based on current robotic ideology calling for the creation of a PowerPoint robot of the humanoid type that embodies the basic theories and concepts contained in a standard psychological description of a human being. Never before attempted in this course, the Robot Project is an original and innovative integration of interactive group learning, multimedia technology, and creativity used to enhance the learning of basic psychological principles.

The concept of creating an artificial life-form for the purpose of human companionship is reflected in ancient mythology, medieval literature, as well as visual art created in the 14th century, specifically Leonardo da Vinci's design of a humanoid known as Leonardo's Robot (Libin & Libin, 2004). Today, humanoid robots are common facets of popular culture as seen in magazines, comic books, cartoons, as well as science fiction movies and novels where robots are both heroes and villains (Asada, MacDorman, Ishiguro, & Kuniyoshi, 2001).

With the growing popularity of robots and artificial intelligence (AI), the creation of robots incorporating some psychological concepts and principles has become increasingly prevalent within higher education curricula. A review of the robotics literature suggests that programs in engineering, computer science, and cognitive sciences have historically dominated the research in and use of these tools. However, as technology advances and the field of robotics has increasingly sought to provide automats with the capacity to learn, develop, and evolve through interaction with their environments, the field of robotics is turning to the social sciences, especially psychology, to enhance the human-like qualities of these artificial life-forms (Dautenhahn & Billard, 1999; Libin & Libin, 2004; Sharkey & Ziemke, 1998). This development has expanded the number of universities and colleges that have begun integrating robotics into various interdisciplinary programs, but few have employed the creation of humanoid beings to improve the teaching of an introductory psychology course.

Current interdisciplinary integration of robotics technology within most college and university curricula is limited to LEGO-based classroom activities and LEGO design and programming tools (LEGO). This method of physically building a robot from a kit is used in education and psychology curricula for studying specific behaviors, adaptation, and experimental methods.

Perhaps the most well-documented psychology course using LEGO robotics technology is a course offered at Indiana University. This course has incorporated the Lego Mindstorm robotics kit as a method of teaching the mechanisms that underlie basic human

behaviors (Instructional Support Services, 2001). More specifically, these robot creations demonstrate programmed behaviors that analogically represent human brain function such as seeking and avoiding obstacles, habit formation, planning, and environmental interaction. Another institution that uses robotic technology is Rensselaer Polytechnic Institute (RPI). RPI offers the "Minds and Machines" program in the undergraduate cognitive science curricula which integrates robotics into numerous interdisciplinary studies, including psychology, philosophy, and computer science (Rensselaer Polytechnic Institute, 2007). Literature on the current uses of robotics in higher education suggests these projects lead to intellectual growth (Instructional Support Services, 2001).

Despite the apparent educational value of these robotics courses, few universities and colleges have incorporated such creative approaches in their General Psychology curricula. The goal of our Robot Project assignment was to allow students to engage in a cooperative team-oriented task that required the creation of a fictional, yet believable, humanoid robot that would replicate a psychologically rich human being. Unlike the mechanical robots emphasized in cross-disciplinary classroom projects using LEGO and other technologically based tools, our project takes a different approach to learning. Rather than focusing on the mechanical aspect of robotic technology to teach specific developmental or behavioral concepts, this project encourages the incorporation of all theory addressed in an introductory psychology course and requires students to think critically, creatively, subjectively, and analytically about what it means theoretically and conceptually to be a human being. As students learn about basic psychological principles at an abstract level and reflect on these concepts, students may also enrich their ability to apply these fundamental theoretical concepts within the discipline of psychology.

Because literature on higher education suggests that creativity is central to both teaching and learning, (Bleakley, 2004; Donnelly, 2004) we encouraged our students to be both creative and innovative in their robot

designs. We did not simply want them to produce a conceptual replication but to develop a new, original "life form." In addition, we believed that making this project a collaborative group effort would be of significant professional value given the trend in many career markets to rely on group interaction and team work wherein members embrace diverse skills and knowledge (Paulus & Nijstad, 2003).

Research on creativity emphasizes the beneficial effects of groups in generating new ideas (Cropley, 2006; Paulus & Nijstad, 2003). It is believed that group brainstorming is a successful tool for stimulating the sharing of ideas, as well as igniting creative energy (Paulus & Nijstad, 2003). In addition, group work places the responsibility of learning onto the individuals and enhances the quality of learning (Mills & Woodall, 2004). As a result, the application of group work has gained acceptance as a learning tool within the field of education (Mills & Woodall, 2004). Therefore, this project is aimed at expanding student experiences of collaborative and active learning, time management, critical thinking, creative brainstorming, and technological skills.

To ensure educational value, we designed this assignment according to Albany College of Pharmacy's Ability-Based Outcomes for general education courses found in the *College Catalog* (2005-2006), as well as two specific course objectives. The ability-based outcomes include (a) thinking abilities involving the collection, comprehension, analysis, and synthesis of information; (b) social awareness, social responsibility, and citizenship abilities demonstrated by the recognition, tolerance, and appreciation of cultural diversity within the working groups; (c) self-learning abilities and habits measured by the design and implementation of personal research and interpretation of research data; and (d) social interaction abilities involved in effective interaction with individuals within group situations, workplace, and professional organizations. The two course objectives specified for the robot assignment were (a) by the end of this general psychology course, students should be able to recognize the value of psychology in understanding and suggesting solutions for real-world problems, and (b) by the end of this course, students will be able to apply psychological concepts, theories, and methods by using them to describe and explain mental processes and behaviors.

Prior to discussing the methodology of this assignment, it is important to recognize the unique student population at Albany College of Pharmacy (ACP). The college is accredited by the Accreditation Council on Pharmaceutical Education and by the Commission on Higher Education of the Middle States Association of Colleges and Schools. The core curriculum is deeply embedded in the natural sciences.

Pharmacology is the primary field of study offered at ACP. The students are not psychology majors and possess learning style preferences toward individuation, tactile learning, and an appreciation for set expectations in

regards to course work and evaluation methodology. The Doctor of Pharmacy degree program is competitive as are the students when it comes to academic achievement. We designed this innovative robot assignment with these student characteristics in mind.

One hundred and thirty-two undergraduate pharmacy students from Albany College of Pharmacy participated in the 2006 spring semester course. The students enrolled in the course were in the second-year of the six year curriculum program leading to the Doctor of Pharmacy (Pharm D.) degree. The students used course lecture notes, textbook concepts and vocabulary, online lab assignments, workshop (weekly 50-min lab sections) materials, and their imaginations to create their psychological robots.

Each student received a copy of a Robot Construction Project description and a list of the Project Milestones at the beginning of the semester. This would be the first time in the history of the course that a nontraditional assignment of any sort would count as a major portion of the overall course requirements (265 out of 1000 points). The robot had to incorporate the fundamental psychological findings, concepts, and theories relevant to human beings. Although not a physical or freestanding robot of human appearance, the robots were to be created on paper in the style of a fictional though psychologically rich biography, as well as a creative PowerPoint presentation of a day or two in the life of the robots sliced from the written biography. The bulk of the raw material could be found in the course text (Gazzaniga & Heatherton, 2005) and the course lectures. The robot should not simply be a humanlike embodiment of the most commonly known theories concerning the nature and behavior of human beings. The robot should clearly suggest a new form of human-like being, indeed, a new species of being. But this robot creation could not be so different from ordinary human beings that it/she/he would fail to help the students to learn and understand the relevance of psychology to describing and explaining human beings such as themselves.

The students were told that it might be helpful in getting started on this construction project to think of it as simply a fictionalized biography rooted in psychological findings and theories. They were also told that it might be helpful to search the Internet using keywords and phrases such as "robots and psychology," "artificial intelligence," "androids," "humanoids," "literature and robots," "films and robots," etc. The students who had never created a virtual animated creature on the computer and were uncertain and nervous about this unique assignment were comforted by the knowledge that the instructors and technical tutors would be available to help in the creative and technological areas of the assignment.

The introduction of the Robot Project assignment also included a presentation of a very simple example of a PowerPoint humanoid with a fictionalized day in her life

(Little Red Riding Hood). The introduction ended with the presentation of a Schedule of Construction Milestones that specified definite project tasks to be completed by set dates throughout the semester. Each milestone would be evaluated separately and the final grade for the robot assignment would be based on all of the milestone grades. There would be one grade shared by all members of the robot construction team.

Throughout the semester, the Robot Project description and Schedule of Milestones were available for viewing via an electronic version of the syllabus. In addition to bi-weekly lectures, the members of the course attended psychology workshops which met once a week under the supervision of one of the two instructors. Each workshop session had between 18 and 25 students in attendance. Using a method similar to systematic sampling, 23 small groups were formed. Each group contained 5 to 6 individual members. In these groups the students completed the assigned (traditional) workshop exercises, as well as the Robot Construction Project. The purpose of this group breakdown was to emphasize collaboration as a tool for learning.

To motivate students to think creatively about their humanoid creations, the instructors presented clips throughout the semester from popular and infamous movies with robots as characters including the films *A.I.* and *I, Robot*. Other tools enabling students to excel in this assignment included access to a Robot Consultation Group made up of student peers with advanced computer and animation skills and tutors in the College Writing Center designated to assist psychology students in the writing of the robot biography. The Director of the Writing Program, who has extensive experience in multimedia communication, was also available to help students learn creative, yet simple, ways to present their robots by PowerPoint.

As described previously, the milestones broke the project down into incremental parts that were submitted throughout the semester. The milestones included a first draft of the overall profile of the robot and its story; the pencil and paper sketch of the eventual computerized appearance of the robot; the individual chapters of the written biography; the outline of the PowerPoint presentation of the "The Day in the Life of the Robot"; the final draft of the biography; the actual PowerPoint presentation; and the submission of the CD-Rom copy of the PowerPoint presentation. The milestones encouraged the use of time management skills and helped the instructors to track group progress on the robot.

Prior to the scheduled date of the final milestone, a self-assessment for a PowerPoint presentation handout was distributed to each group to assist them in their final editing. Final drafts were submitted by all 23 groups on the first day of the scheduled presentations. The reason for the simultaneous submission was to ensure that all groups were allotted the same amount of time to complete the task. Final draft submissions included one paper

copy of the biography component, a printout of the PowerPoint presentation, and one copy of the PowerPoint animated presentation submitted via a CD-Rom.

Group presentations were scheduled two per workshop session over the last two weeks of the semester. Following a required outline of the multimedia presentation, each of the 23 small robot construction groups exhibited their completed PowerPoint within a 15 to 25 min block. The PowerPoint representation of "A Day in the Life of a Robot" was preceded by a brief introduction whereby all group members had the opportunity to help introduce a portion of their creation. This introduction amounted to a summary of the overall psychobiographical description of a humanoid robot and served as a stage for the PowerPoint representation (picture and sound) of the robot's environment and experiences.

A question and answer session followed all presentations. Both fellow students and instructors asked questions about the creative process leading to the completion of the humanoid. In addition, the instructors asked each group about the most difficult aspects of building a paper and PowerPoint robot that ultimately appears much like a genuine psychological human being.

The Robot Construction Project had a weighted value equal to one quarter of the course grade (265/1000 points). Final evaluation and grading was based on the completed milestones, creativity in connection with the robot itself and the biography, the integration of all relevant course material, and both the technical and creative aspects of the multimedia presentation. The final products of the robot construction groups were of a higher quality than the instructors expected at the beginning of the semester. Completed milestones throughout the semester led the instructors to believe the assignment was gradually receiving more and more serious attention. The work appeared to be driven by the students' learning styles (tactile, task-oriented), cultural backgrounds (computer technology, video games, cinematography, science fiction), and competitiveness. The students' requests for assistance from the instructors as well as consultations with tutors in the Writing Center and Peer Consultants indicated that the assignment was being managed well and that favorable results were to be expected.

Among the most fascinating and believable robots created was LASI (Learning Analytic Synthetic Intelligence) whose monologues on the relationship of humans and humanoids were so captivating the instructors forgot they were responsible for assessing the students' work. The instructors were so taken by the humanoid's trials they experienced real feelings of sympathy for him (it). The PowerPoint slides along

with slices of the robot's monologue presented in Appendix A represent more than half of the entire presentation.

Additional examples of the varied types of humanoids created include a nanny who is severely jealous, a member of a unique extended family, a prostitute, a missionary teacher in Africa, a personal servant, a pharmacist (of course), a subject of a behavioral modification experiment, a practice child for future parents, an emergency room physician, a romantic companion for hire, a human relations counselor, and a globe-trotting environmental engineer.

The Robot Construction Project appears to have been an engaging and rewarding assignment in an introductory psychology course in the spring of 2006. The idea of such an assignment did not originate in any specific body of pedagogical literature but in our awareness of the obvious fascination with robots and technology in general among college-age moviegoers and science fiction readers. This cultural awareness, as well as our knowledge and appreciation of our students' learning styles, and appetite for the positive response potential in innovative and interactive learning, greatly influenced the use of this humanoid robot assignment.

Within some of the Robot Construction groups, the lack of willingness of some members to engage in the collaborative work process may have had an inhibitory affect on the outcome of the project. Because of the instructors' warnings that failure to give evidence of a commitment to collaborative effort would be reflected in the final evaluations, most groups worked out their resistance to the required collaborative effort on their own. This occurrence supports the notion of effective problem solving in the group setting (Cropley, 2006; Paulus & Nijstad, 2003; Waller, Conte, Gibson, & Carpenter, 2001). Conversely, this lack of enthusiasm for collaborative work is also reflective of Copley (2006) and Donnelly's (2004) research on inhibitory effects and the suggestion of diminished individual efforts. Nevertheless, the resourcefulness, general collaborative effort, creativity, and the overall high performance on exams and quizzes by the students, strongly suggests to one instructor who has been teaching this course for the past seven years that a more stimulating and enduring learning experience took place in 2006 than in previous years.

It has been during the preparation of this article that we have become aware of the general absence of any attention to robotics and the possibilities of its application to the enhancement of learning within the field of psychology education. We did find evidence of the use of machine-like robots with plastic and metal materials for the purpose of studying behavior, adaptation, and experimental methods, but we found no literature that would have inspired us to ask our students to build a humanoid with a life to live with other such robots and human beings (Cardaci et al., 1999).

Although there were students who expressed displeasure with the assignment, there appears to have been general satisfaction with the Robot Project. A more in-depth statistical determination of just how effective the Robot Project may be in terms of its contribution to the learning of general psychology principles will have to wait upon the assessment of learning in future editions of the course. Three of the most critical questions we hope to answer upon further assessment are (a) Does an interactive, group and hands-on assignment, calling for creativity in conceptualization and production, enhance the learning of psychological principles in a general psychology course?, (b) And if innovative projects enhance learning, by which method is this learning assessed most reliably?, and (c) Does the creation of a human-like robot incorporating the basic theories and principles of human psychology and their imagined extension through the construction of a fictionalized biography and PowerPoint representation qualify as such a pedagogical method?

The Robot Project challenges students with aptitude for both creative/descriptive writing (biographical) and applied computer technology (PowerPoint cartooning and animation). Students who are academically competitive with a preference for innovative learning opportunities are also challenged. The observed success of this 2006 assignment strongly suggests that this is a learning tool worth replicating in future offerings of the general psychology course. In addition, the skills of collaborative and active learning, time management, critical thinking, creative brainstorming, and use of classroom technology may enhance effective student learning in future coursework.

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Notes

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Appendix A
Example PowerPoint Slides and Monologue



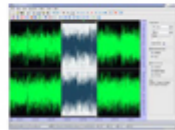
Salutations!

Learning Analytic
Synthetic Intelligence

"Humanity Exceeds Physicality..."

I am here to introduce myself, and to discuss my own biography. I wish to convince you all that humanity exceeds physicality.

What allows me to function:



To begin, I exist. My existence is not in question; I am here. I am tangible and I am real. However, if I exist as a person and as an identity presents a different question.

androgynous



However, I do vary from people; I am neither male nor female, I am androgynous.

Development

- Jean Piaget
 - Object permanence
 - Accommodation



Who's that good lookin' guy?



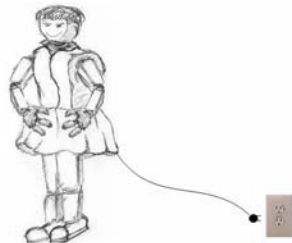
My development proved to be similar to that of a child. I quickly began to recognize such things as object permanence, and accommodation.

Morality



Morals were more difficult to develop since many individuals had biases against me due to my robotic nature. Also, my androgynous nature formed a major gender identity crisis for me, because I am alone in this physicality. Despite this, I have naturally progressed in my social and mental development

I begin my day by disconnecting myself from my charger, much as humans wake up...



I begin my day by disconnecting myself from my charger, much as humans wake up. Luckily I am never groggy. I spend my mornings working on my stamp collection. I find it soothing.

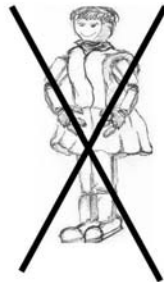


On weekends, I attend a series of classes on how to dance because I like to exercise my physical capabilities...



I have many of the superior qualities that eugenics seeks... but I fear the rejection I would receive due to my artificial status

Rejection



Moral Dilemmas



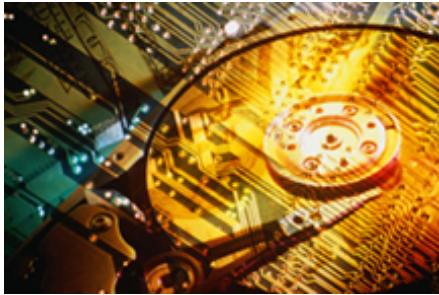
Eugenics interests me because I am not physically human, and have many of the superior qualities that Eugenecists seek; and yet I am at times shunned and made an outcast from society. I fear the rejection that I experience due to my artificial status. I may be a scientific creation of great wonder, but I am thought of as inferior.



Humans believe I am inferior



I am more than automation



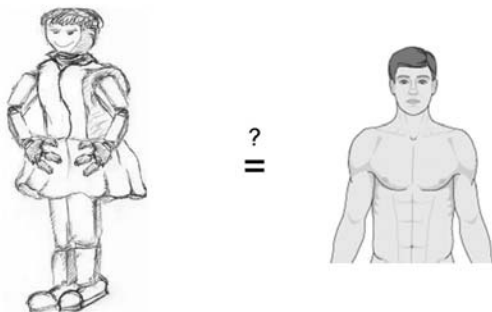
By this point in time, I have no doubt you are curious as to how I function. I have shared with you a little bit of what I can do, but not how I can do it. I am not an automaton. My processing center (a brain) is designed to hold a digital neural net. Much as humans use schemas, my education algorithms function in a similar way.

Identity

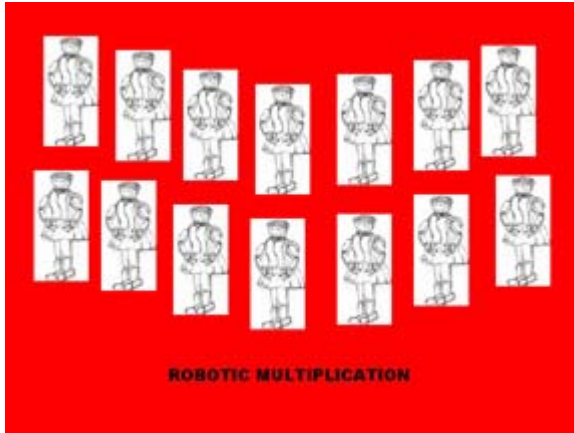


I have been given a name, a birth date, and a variety of other particular information. What all of these things gave me you will recognize as an ego, and, therefore, an ego border. With this in place, I was able to begin using and manipulating my neural net and education algorithms. Without an identity, I had no frame of reference.

Biases in existence



I have creativity that has been programmed into me, with which I create reflexively, or intuitively. And yet, since this is not considered true imagination, there is still a chasm between myself and humans. Does this one difference make me less than human (or humanlike)?



While I may be just one, in the coming future there will be a significant increase in those who are like me. If they are not treated as humans, and as equals, albeit different, then history will repeat itself. Those who will follow me, and who are like me and much more, may be forced to look at themselves as inferior and they will revolt.



This is not a message of fear, of offense, or of warning; it is merely the logical conclusion if people maintain their bias, and their ignorance. I have no hatred, no anger, no intentions of violence; the same cannot be said for those others that will be created.
