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BY THE SWEDISH COGNITIVE SCIENCE SOCIETY

EDITORS
Erik Billing,
Jessica Lindblom, and
Tom Ziemke
Preface

Welcome to SweCog 2015!

The aim of the Swedish Cognitive Science Society is to support networking among researchers in Sweden, with the goal of creating a strong interdisciplinary cluster of cognitive science oriented research.

This little booklet contains the abstracts of the invited talks as well as all oral and poster presentations at the 2015 SweCog conference (in alphabetical order). In addition to the usual interdisciplinary mix of research that is typical for cognitive science meetings, this year’s conference also seems to challenge some of the fundamentals of mathematics: One of the invited speakers claims that $1 + 1 = 3$, and as organizers we would like to assert that $2 = 11$, given that this is both the second and the eleventh SweCog conference. If you doubt that, there’s something to discuss in the coffee breaks...

Last, but not least, we would like to thank the many people that have contributed to this conference, including many colleagues at the University of Skövde, and in particular of course all authors and reviewers.

## Conference Program

Conference chairs: Jessica Lindblom and Erik Billing.

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User experience of affective touch in human-robot interaction

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Robotic technology is quickly advancing and robots are entering both professional and domestic settings. An increased application of robots in elderly care and in therapy shows a shift towards social robots acting in human environments, designed to socially interact with humans. Socially interactive robots need to act in relation to social and emotional aspects of human life, and be able to sense and react to social cues. Touch, as one of the most fundamental aspects of human social interaction (Montagu, 1986) has lately received great interest in human-robot interaction (HRI) research (e.g. Dahiya et al., 2010; Silvera-Tawil et al., 2015) and the interpretation of touch in robotics has been presented as an unresolved research area with a crucial role in further development of HRI (Silvera-Tawil et al., 2015). It has been argued that the communicative distance between people and robots would be shortened and that the interaction would be more meaningful and intuitive if robots were able to “feel”, “understand”, and respond to touch in accordance with expectations of the human (Silvera-Tawil et al., 2015). However, this reasoning takes the notion of user experience (UX) for granted. The concept of UX embraces both pragmatic and hedonic aspects of interaction with technology in a particular context (Hartson & Pyla, 2012). In the field of human-computer interaction, UX has been acknowledged as a key term in the design of interactive products, but UX has not been emphasized in HRI. Accordingly, this research argues that it is important to study not only the robotic technology aspect of tactile interaction but also the user’s experience of the interaction, i.e. taking on the human-centered HRI approach presented by Dautenhahn (2007). Research on human-human interaction has showed that humans are able to communicate emotions via touch, and that specific emotions are associated with specific touch behaviors (Hertenstein et al., 2009). As a starting point for narrowing the distance between UX and HRI, the present research suggests a study where subjects are instructed to convey specific emotions to a humanoid robot. The study aims at investigating the role of affective touch in HRI with a focus on touch behaviors (e.g. stroking, grasping) for specific emotions, touch locations on the robot, and user experience of interacting with the robot via touch. The intended contributions of this study are an increased understanding of the necessary properties of tactile sensors enabling affective touch in human-robot interaction, the relevant placements of the sensors on the robot, and how the robot’s “look and feel” affects the user’s experience of the interaction. The proposed research embarks on a new track of HRI research and will, contrary to prior research on tactile interaction in HRI, emphasize the user experience of affective touch, highlighting that a positive user experience has to be systematically and consciously designed in order for the social robots to achieve the intended benefits of being socially interactive. Accordingly, the proposed study is believed to give new insights about the understudied dimension of UX in HRI, with the potential to enrich interaction between humans and social robots.

References

We present a novel developmental architecture motivated by findings from neuroscience and learning theory. Through interaction between many different cognitive subsystems, a surprisingly large number of flexible goal-directed behaviors evolve over time. The architecture includes mechanisms for goal-directed bottom-up and top-down attention, reward-driven and anticipatory learning as well as goal-setting and navigation. There are also a number of memory systems in the architecture serving different functions, including a working memory that stores spatial-feature bindings. The architecture allows a robot to show great flexibility by being able to adapt to an arbitrary environmental layout and to manipulate objects and combine them into any configuration that it has previously seen. The architecture has been tested on a visually guided mobile robot with a manipulator that allows it to stack blocks.

One of the cornerstones of the architecture is the idea of attention as selection-for-action (Allport, 1990), which leads to a view of action execution as consisting of two stages (Balkenius, 2000). In the first stage, a target object is selected by the attention system (Balkenius, Morén, & Winberg, 2009). At this stage the particular action to perform is not yet determined. In the second stage, one of potentially several actions compatible with the target object is selected.

On the lowest level, actions consist of small attention controlled goal-directed behavior fragments that increase the probability that randomly selected actions will lead to useful consequences. The behavior produced at this level is subsequently used to train a context sensitive reinforcement learning component (Balkenius & Winberg, 2008). The final control level depends on outcome-action associations that can be used for situated simulation of actions. When the attention system has selected a target object, it is able to look ahead to evaluate the utility of different actions and future targets before selecting the action to execute.

A target object can also be selected from memory. If the object is not directly visible, the spatial memory system will be used to recall the location of the object and a place-field-based navigation system is invoked to construct a path to the location of the remembered object.

The robot adapts to a changing or novel environment by relearning or by restructuring the environment to match its expectations by moving objects around (Friston, Daunizeau, Kilner, & Kiebel, 2010). The architecture also allows for human interaction even though no part of the architecture was designed specifically for this. The robot can interactively be taught to build novel designs, a human can help the robot, and the robot can even help a human builder if it recognizes what she is building. As there is currently no explicit social component in the architecture, these abilities all depend on learning to predict regularities in the environment.

References

Robots that interact with people using one or several communicative modalities have been around for almost 20 years. The technological challenges of creating robust human-robot interaction are huge, and progress in building the artificial intelligence required to make autonomous social robots has been unsteady. But even though the social performance of robots is far from that of humans, the gaps in the robot's social cognition are often plugged by humans' gregarious social cognition. As such we are now at a time where the science and technology of social robots is mature enough to be useful. This talk will give a brief overview of the current state of the art in social robots, and will show how the cognitive sciences are central to building social robots and understanding how our behaviour towards social robots. In a second part, the talk will dwell on the applications of social robots, and will show how they can be used as hospital companions and teachers.
Affective robotic tutors

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Recent research on personal robots shows that robots are increasingly being studied as partners that collaborate and interact with people [1]. Robot companions [2], for example, are envisioned to play an important role in several applications, such as providing assistance for the elderly at home, serving as tutors for children by enriching their learning experiences, acting as therapeutic tools for children with autism or as game buddies for entertainment purposes.

This paper presents ongoing work in the EMOTE project (www.emote-project.eu) aiming to develop personal robots that act as robotic tutors. EMOTE is building a new generation of robotic tutors that have perceptive capabilities to engage in empathic interactions with learners in a shared physical space. The project proposes to build tutors that enrich learning experiences by (a) monitoring the learner's abilities and difficulties throughout the learning process; (b) modelling affect-related states experienced by the learner during the learning task and the interaction with the tutor; (c) providing appropriate feedback to the learner by means of contextualised empathic reactions, adaptive dialogue and personalised learning strategies.

In order to build an intelligent artificial tutor with affective capabilities, an appropriate computational model needs to be developed and properly trained to automatically recognize and classify the emotional state of the user. For training purposes, representative data is required. A Wizard-of-Oz (WoZ) study was performed to collect multimodal data from school pupils aged between 10 and 13 interacting with a Nao robot acting as a tutor while performing a map reading task on a multi-touch table. During the study the robot was controlled by an experienced teacher using a bespoke networked Wizard control interface which allowed full control over the various parts of the system. The robot has been endowed with a large collection of flexible utterances and predefined naturalistic behaviours to help scaffold an interaction. The creation of Nao's behaviours and utterances are based on an extensive literature review and inspiration drawn from our previous human-human studies with teachers and students from different European cities using a mock-up prototype of the educational activity. During each session, we manually captured three videos via digital camcorders. Simultaneous video feeds from the cameras, the Q sensor from Affectiva (i.e., electro-dermal activity and temperature), OKAO from Omron (i.e., facial characteristics such as expression estimation and smile estimation, eye gaze information and blink estimation) and the Kinect sensor (i.e., head gaze information, depth and facial action units) were recorded during the tutor-learner interaction. The interaction between the tutor and the learner in terms of tutor dialogue actions, utterances and learner responses in terms of button presses was also logged. Videos and data are currently being analysed in order to build a user model that accounts for the affect of the learner.

Acknowledgement

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References

Did the practice of Partible Paternity select for Emotional Intelligence? A systematic review of Ritual Couvade in lowland Indigenous Amazonian societies

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Abstract

Evolutionary psychology is based on the assumption that psychological traits must have been selected as a result of natural and sexual selection. Amotz Zahavi (1979) suggested that some traits that appear to be non-adaptive, by inflicting great costs on the individual expressing them, are nevertheless beneficial for its progeny, and are therefore selected for by the opposite sex. The purpose of the present thesis is to explain an unusual behavior called ritual couvade that is common amongst a large part of the Amazonian Indigenous populations. It is related to their belief that a child is the result of the mother engaging in multiple copulations with different men, and their recognition of each of these men as co-fathers, which is known as Partible Paternity (Beckerman et al., 1998; Beckerman et al., 2002; Beckerman & Valentine, 2002) in the anthropological literature. Given this inability to determine paternity, Indigenous males remain oblivious as to whether their parental investment is directed towards their biological child. I propose that the ritual couvade constitutes a symbolic re-enactment of birth-giving, which attempts to portray an empathic commitment towards the pregnant mother, and whose ultimate purpose is to become selected for the genetic father role during subsequent pregnancies in exchange for committing increased paternal responsibility towards the present child of indeterminate genetic origin.

By considering the present-day Amazonian foragers as a working model for our evolutionary past, I suggest that paternity confusion is the optimal stressor condition for the emergence of the cognitive traits at the base of male enhanced empathic behavior display. Specifically, I will compare the feasibility of three hypotheses. First, that in patrilineages ritual couvade is an exclusive formal sanctioning of the primary father, which provides no biological advantages to the performer. Second, that in matrilineages, secondary fathers are encouraged to perform ritual couvade in order to gain indirect genetic benefit by displaying emotional commitment. Third, that in ambilateral groups women form philopatric residential clusters to enter in non-fraternal polyandrous marriages. The latter marriage arrangement generates the highest degree of paternity confusion, and induces thereby a higher level of paternal care within the realm of the cultural and environmental conditions of Amazonian Indigenous populations.

To these ends, I carry out a systematic review of published research with the keywords Partible Paternity and Ritual Couvade using the JSTOR database. The search result consisted of 13 mainly anthropological journal articles of a descriptive nature, showing that in ambilateral groups believing in Partible Paternity, women tended to enlist kinsmen as husbands depriving ritual couvade of the evolutionary force required for the emergence of trait emotional intelligence (ref., e.g. Goleman, 1995). Putting these findings into the context of Life History Theory (Figueroedo et al. 2006; Rushton 1985), it seems likely that female sexual promiscuity among Amazonian lowland Indigenous populations (Crocker, 1990, 1994) increases women’s fitness and the survival of their offspring by increased paternal support (Beckerman et al., 2002, Beckerman & Valentine, 2002; Hill & Hurtado, 1996; Pollock, 2002).

References


Throughout history, pets have lived in close contact with humans and have now become central to family life, providing companionship and pleasure, and are often considered as family members. During the last decades, research has emerged that shows health benefits associated with interactions with companion animals. For example, pet ownership has been shown to improve cardiovascular health, animal contact have positive effects on empathy and can reduce the subjective feeling of anxiety and promote calmness. Some animals have the potential to reduce depression and to improve the mood of people who receive treatment for mental health problems or patient in long-term care. These animals may also influence trust toward other humans. In addition, children having a dog present in their classroom display increased social competence. Interaction between dogs and their owners have been shown to induce oxytocin release in both the dogs and the owners and it seems as if oxytocin is a major player when it comes to orchestrating the effects of human-animal interaction. Both the physical contact with the dog and the attachment of the owner to the dog seems to play important roles in generating these effects.
Interacting with the environment for remembering intentions: from normal to atypical cognitive aging

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In the poster I compare normal cognitive aging and people with aging-related neurocognitive diseases in terms of prospects and issues for utilizing the physical environment (see for instance Clark, 2005) for forming and executing intentions at an appropriate point in time and space (known as prospective memory, PM). The comparison is based on (a) a previously conducted cognitive ethnography on normal older adults and (b) an ongoing literature review on, and recently initiated observations of, and interviews with people with a dementia diagnose. Such comparison can for instance be important for future developments of practices and artefacts for both a normal and atypical population.

Cognitively normal older adults (+65) are known to perform better in real-life experiments measuring PM than what is predicted from their performances on laboratory-based experiments (known as the age-prospective-memory-paradox, see for instance Kvavilashvili & Fisher, 2007; Phillips, Henry, & Martin, 2008; Rendell & Thomson, 1999; Uttl, 2008). Some studies explain this by suggesting that older adults are more efficient than younger adults in their utilization of the physical environment to remember (Maylor, 1990, see Uttl, 2008 for another explanation). Almost no studies have used observations in real-life to describe the mechanisms of the efficient uses (see Palen & Aaløkke, 2006 for an exception). I have throughout my cognitive ethnography on older adults and PM observed several inter- and intra-individual differences of practices used to more or less efficiently couple with the environment to deal with activities such as leaving home with intended objects. One such group of beneficial practices deals with the deliberate or more automatic practices of retrieving information from an environment (an environment that can be more or less shaped to deal with specific PM situations, Kristiansson, Wiik, & Prytz, 2014). From these observations I have concluded that a reason for why people manage PM situations in real life is because they most of the time efficiently and rather quickly perceive and interpret features in the physical environment as cues for previously formed intentions; and thereby are reminded of what to do when in an upcoming or ongoing activity.

For the study of people with a dementia diagnose some observations of real-life situations exist in previous literature. For instance it is to some extent known that a good shaping of the physical environment can be absolutely crucial for them being able to keep track of near-future intentions (see for instance Vikström, Borell, Stigsdotter-Neely, & Josephsson, 2005 on the activity making tea). A good shaping can for instance be characterized by reducing the demand of attentional resources by the creation of more salient features. But it is also known that for a dementia diagnose, for instance in the case Alzheimer’s disease the progression is characterized by a neurocognitive deterioration of areas related to perceptual abilities (Braak & Braak, 1995). Therefore, despite that the shaping of the physical environment is important for supporting attentional resources, perceptual and interpretive issues of an external feature can still result in an inefficient coupling with the environment to remember intentions. It seems that people with dementia disease, more than the general older population, have to rely on more explicit cues and physical constraints to manage PM situations in real life. A part of the inter-individual differences in practices among the typically developed older adults I have observed deals with the variation of how explicit cues they create, and how much they physically constrain the likelihood of being reminded by their environment. It can therefore be the case that some older adults use practices that are more adapted to an everyday life with neurocognitive diseases, or adapted to living more cognitively challenging everyday lives for other reasons. Since a large majority of research on dementia is based on the perspective of a significant other, and also how the significant other shapes the physical environment for the person with dementia disease, I aim to add to the field by empirically describing the practices the person with dementia use to utilize the physical environment to keep track of future intentions.
References


Measuring the noticing of an unexpected event in Magical Garden with a Teachable Agent using Eye-Tracking

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Not developing number sense in childhood can have dire consequences: failing early mathematics and developing learning disabilities later on (Griffin, Case, & Siegler, 1994; Gersten, 1999; Chard et al, 2005). How do you catch children’s attention and promote learning? The importance of play as a pedagogical tool for teaching and to get children motivated in their acquisition for new abilities has been known for many years (Griffin, Case, & Siegler, 1994; Geary, 1995; Gee, 2003). With new technology, a genre of educational games for mathematics has emerged. Utilizing the motivational and captivating power of computer games, educational games for mathematics have shown an effect on both learning and motivation (Schwartz, 2004; Moreno, 2005). The educational game Magical Garden has all the prerequisites for training and testing number sense, and the help of a Teachable Agent (TA). Axelsson et al. (2013) requested further research on preschooler’s social interaction with TA. Schneider et al. (2008) emphasized the validity and utility of using eye-tracking as a measure of developing number sense. The close connection between top-down control and eye movements (Henderson, 2003; Deubel & Schneider, 1996), as well as Smith (2012) provide grounds for considering that noticing something unexpected could be manifested as visual attention towards an Area of interest (AOI).

In the present study, eye-tracking was used as method to record if children noticed an unexpected event in Magical Garden. The unexpected event was designed in a way that only the children who had a sufficient level of number sense would react and notice the unexpected event. The unexpected event was a tree elevator malfunction; the elevator passed the correct level and crashed in the tree top. A model of detection was proposed: Looking back at the AOI of the correct level. The corresponding hypothesis was: “Looking back” would correlate with the performance in Magical Garden. Performance was the rate of correct answer in the eye-tracking session. Other eye-movements such as anticipation, and looking at the elevator button were collected.

In this study, 40 preschoolers participated (21 girls, M=4.6, SD=0.72), from three preschools, in the south of Sweden. The study consisted of two phases; first a training phase, and then an eye-tracking experiment. The eye-tracking experiment was conducted at the preschools, by having children play the specially designed version of Magical Garden. The child and the TA took turns being in charge in the game. Will the children look at the TA during an unexpected event and is there a difference in “look at TA” depending on who was in charge?

A significant result was found in that “looking back” correlated to performance, \( p = 0.018, \) 95% CI of \([0.067 – 0.679]\). A significant difference was found in that children looked at a higher rate at the TA when the TA was in charge, \( p < .001, \) 95% CI of \([0.064-0.223]\). With an explorative look at the eye-movement data, “looking at the elevator button” correlated strongly with performance \( r(38) = .50, p < .001. \)

This study introduces the noticing of an unexpected event as novel way of getting children to expose their level of number sense without being in a test situation. The proposed model of noticing, a look back, did not account for the whole notion of detecting an unexpected event. However, a better model of noticing could be constructed by combining measurements of verbal, non-verbal detections, as well as eye movements such as “look back” and “look at button”. Future research could learn from this study and examine the possibility of creating a better model of noticing.

References


Perceiving, learning, and reasoning in arbitrary domains

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When Alice in Wonderland fell down the rabbit hole, she entered a world that was completely new to her. She gradually explored that world by perceiving, learning, and reasoning. This paper presents a system Alice In Wonderland (AIW) that operates analogously. We model Alice's Wonderland via a general notion of domain and Alice herself with a computational model including an evolving belief set along with mechanisms for perceiving, learning, and reasoning. The system operates both manually with human intervention, and autonomously by learning from random streams of facts from arbitrary domains. It has proven able to challenge average human problem solvers in such domains as propositional logic and elementary arithmetic.

The paper improves and extends on our previous work (Strannegård, Nizamani, & Persson, 2014; Strannegård, Nizamani, Juel, & Persson, in press 2015). The earlier versions of this model were able to learn and reason in arbitrary domains, albeit when fed with carefully selected examples. The current system can learn from arbitrary streams of observations, with or without human intervention. The computational complexity of the system is restricted by using a simple cognitive model with bounded cognitive resources. This cognitive model is not a psychologically plausible model of human thought, but is useful nonetheless in reducing the computational complexity in an artificial reasoning system. It forms the basis for deductive reasoning, and learning of inductive rules is improved by a refined method of abstraction and satisfiability. Introspection enables the system to check for soundness of the potential rules before updating the belief set. The system is constructed with formal definitions of involved concepts, and examples are used to illustrate its basic usage.

Most artificial reasoning systems are narrow and only understand a single domain. This system is designed to achieve general intelligence, although limited to unambiguous symbolic domains. This seems to be a severe restriction, however, achieving general intelligence in even such domains is a way forward to achieving the larger goal of realizing artificial agents with a broader general intelligence. This model may also be useful in understanding formal and mathematical properties of reasoning.

References


How do car drivers make decisions?

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A car simulator study with 80 participants (aged 55-75 years) has been carried out at the Swedish National Road and Transport Research Institute (VTI). Drivers in the study were confronted with varying traffic events that “normally” occur in regular traffic. One example is roadworks in the opposing lane, where oncoming cars neglect their obligation to give way and continue to drive past the roadworks instead. Another example is when a child runs out in front of a bus at a bus stop in the driver’s lane. A third example is when a parked car suddenly starts to drive out in front of the driver. The events were used for creating safety marginal measures, such as time-to-collision (TTC) to a car ahead for instance. Before the driving session, the participants filled in questionnaires, one of them concerning the likelihood of different factors being the cause of accidents in traffic (i.e. Traffic Locus of Control, T-LOC). Based on results from the T-LOC questionnaire, the drivers have been categorized in one out of three groups; as either finding that the likelihood for other drivers to cause an accident is much larger than for themselves (Others), that the likelihood of causing an accident is about equal for themselves and other drivers (Equals), or somewhere in between Others and Equals statistically (Betweeners). The aim is to examine whether or not there is any difference in tactical decision-making between the different driver categories discussed. The main goal of the approach is to understand drivers’ different decision making strategies and how they affect traffic safety.

Until now there have for instance been studies in simulators where the participants could make subjective ratings of e.g. feelings of risk (Lewis-Evans & Rothengatter, 2009) or how certain they are that they would be able to avoid a collision if they encountered a deer on the road (Schmidt-Daffy, 2014). There have also been studies on on-road behaviour of drivers using an on-road driving evaluation scoring system for finding out which cognitive abilities and personality traits are related to driving performance among older drivers (Adrian, Postal, Moessinger, Rascle, & Charles, 2011). However, connecting views of control to driver behaviour in a car simulator has, to the best of our knowledge, not been attempted before.

References


Dualistic Thinking and Investigations into Consciousness:
Will the “Right” (Non)-dualism Please Stand Up?

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It is common to treat all dualism as Cartesian substance dualism and all dualism as consequently bad. However, dualism comes in a number of flavours, not just the well-known alternative of property dualism, where “mental” and “physical” reflect not distinct substances but distinct sets of properties of a common substance; or David Chalmers’ naturalistic dualism, which many dismiss – wrongly, I think – as nothing more than substance dualism.

The call is frequently made to resist dualistic thinking in any form – but that cannot be right. In a crucial sense, “dualistic” thinking is fundamental to our conceptual nature, deriving ultimately from the way that our ability to identify something as an X depends on our ability to divide the world into Xs and not-Xs. While the various schools of philosophical dualism take this practical conceptual requirement and elevate it to the metaphysical stage, the idea of getting rid of dualisms altogether is hopelessly naïve and logically impossible.

In assessing varieties of dualism, it is useful to distinguish between those whose claims are essentially ontological – thinking here primarily of variations on substance and property dualism – and those whose claims are more epistemological. In the latter category, I place my own preferred form of dualism, which I prefer to call perspectival dualism, although it is closely related to the position known as neutral monism, with such well-known advocates as Spinoza, Bertrand Russell, and William James.

According to perspectival dualism, “mental” and “physical” reflect competing, complementary, mutually necessary (each requiring the other), and yet ultimately irreconcilable views on one and the same world – perspectives that we glide for the most part effortlessly and un-self-consciously between to the extent that the two perspectives appear to blur into one. This key insight is my reason for preferring perspectival dualism over other expressions of neutral monism and related positions.

Such philosophical conundrums as the so-called mind/body problem and explanatory gap arise because of a largely unchallenged belief that there should and can be one, single, “correct” way of looking at the world. The reality may well be that most if not all sufficiently complex phenomena simply do not have one, single, “correct” explanation. The irony in that case is that all the “bad” forms of dualistic thinking arise precisely because of resistance to perspectival pluralism, grounded in perspectival dualism.
Seeing red: Picking flowers in Minecraft with Q-learning

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Robots are stupid. Though we have made them do amazing things, we still cannot tell the garden robot to pick a nice bouquet of flowers as it needs to learn to properly distinguish weed from flower. To be fair, this particular problem is one shared with many untrained humans, but how can we expect to teach the difference to a robot when we don’t understand how human gardeners learn? Recent developments in cognitive science points to a view of the brain as a pattern predictor where top down connections try to predict the incoming sensory input (Clark, 2013). In the related field of machine learning, there is currently a large hype around so called deep neural networks (Bengio, 2009). Such networks use a structure of hierarchical layers similar to the cortical layers in the brain. In relation to human and animal behavior, the results of Mnih et al. (2013, 2015) are especially interesting. They trained a “Deep Q-network” to play 49 two dimensional video games as well as - or better - than an expert human player. This was accomplished with only pixel values and game score as input. The method was based on the Q-learning algorithm (Watkins & Dayan, 1992) combined with deep learning methods. This type of reinforcement learning resembles operant conditioning as used for animal learning; for every action there is reward or punishment (Staddon & Niv, 2008).

Inspired by these results, we attempt a similar but simplified algorithm for teaching an agent with Q-learning. Can this approach be useful to robots and virtual agents seen as embodied creatures in a three dimensional environment? In order to simulate an environment more similar to the one a robot or animal would navigate, the three dimensional video game Minecraft was chosen. Its game world consists of cubes that are combined to create fields, forests, hills, plants and animals much like how Lego works. The player sees this world in a first person view and can move around by using the mouse and keyboard. Interaction mainly consists of “chopping” (hitting) blocks to collect materials which allows for placing blocks to build structures.

The goal is to teach an agent to find and pick as many red flowers as possible, using only game screen pixels as input and the amount of flowers picked as reward signal. An innate behavior was added, causing the agent to “chop” if it sees red in the center of the screen. Each training episode takes place in a flat rectangular “pasture” filled with red flowers on grass and surrounded by walls to contain the agent. As not all chops are successful (the flower might be too far away), the agent has to learn how to navigate its environment to maximize the size of its flower bouquet.

Using the number of picked flowers as a performance measure, we explore different types of learning mechanisms, comparing the performance of our Q-learner to a random flower picker.

References

Versatile Systems Based on Reinforcement Learning

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The goal of artificial general intelligence is to create general intelligence at the human level or beyond (Goertzel & Pennachin, 2007). To get anywhere near that goal one needs to construct versatile agents that can adapt to a wide range of environments without any human intervention. In natural nervous systems, reinforcement learning is a powerful mechanism that enables organisms to adapt to different environments and survive there (Niv, 2009). In artificial systems, reinforcement learning has been used as the basis of relatively versatile agents, e.g. for robotic locomotion across different anatomies and for gaming across different arcade games (Mnih et al., 2015).

In this talk I will discuss how still more versatile systems might be constructed, e.g. systems that can both learn how to move like a snake and how to do simple mathematics. The formalism used is a variation of the transparent neural networks (Strannegård, von Haugwitz, Wessberg, & Balkenius, 2013). The long-term memory is a network of this kind that develops dynamically, partly based on factors relating to reward. The working memory is also a developing network of the same kind, but with strict limitations imposed on its size.

The actions are stored in the long-term memory and they are of two types: physical actions that activate motor sequences, and mental actions that transform the working memory. The physical actions are used for generating motion and the mental actions are used for generating computations with bounded cognitive resources, e.g. in simple mathematics.

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Social attitudes toward robots with different degrees of human-likeness

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The physical appearance of robots that are supposed to interact with people is important because it helps establish social expectations. Just as in the case of humans and animals, the external features of robots can function as indicators for the internal mechanisms that govern their behavior. Employing degrees of human-likeness in the physical design of robots is associated with both positive and negative effects on people’s attitudes toward them. Doing so can serve as a design strategy to facilitate meaningful social human-robot interaction, but it can also give rise to “uncanny” feelings or frustration by failing to meet social expectations. The causes of these effects are poorly understood.

In an experimental setup, 164 Swedish university students answered a questionnaire concerning their attitudes toward robots. The questionnaire design was based on previous research on the Negative Attitudes toward Robots Scale (NARS; Nomura, Suzuki, Kanda & Kato, 2006). NARS includes 14 questionnaire items divided into three subordinate scales, covering different kinds of negative attitudes. The scale has previously been used in a range of scenarios to identify several factors which affect people’s negativity toward robots, including gender, age, prior experience and cultural differences (Tsui et al., 2011). Each participant was randomly assigned a questionnaire displaying one of three robot images: a non-, semi- or a highly anthropomorphic robot type. The results suggest that employing anthropomorphism in robot design affect attitudes toward robots negatively primarily when the robot is intended for social interaction. The semi-anthropomorphic robot type was perceived as less socially appealing—more unnerving, dangerous, less dependable and less suitable for interaction with children—when compared to the other robot types.

There have been several proposed explanations to the negative effects associated with anthropomorphic robot design. Some of them are based on the idea that negative effects are elicited by incongruent social expectations which arise when people fail to understand or predict a robot’s social behavior. For example, MacDorman and Ishiguro (2006) proposed that such effects “may be symptomatic of entities that elicit a model of human other but do not measure up to it”. Ferrey, Burleigh and Fenske (2015) demonstrated that the mid-point between images on a continuum anchored by anthropomorphic and non-anthropomorphic entities produced a maximum of negative effect. The fact that the semi-anthropomorphic robot type gave rise to more negativity than the non- and highly anthropomorphic types can be explained by a failure to understand or predict the behavior of the robot and how to (or indeed whether to at all) interact with it socially. Further research on the effects of robot anthropomorphism on attitudes toward robots is needed to establish whether the proposed explanation is correct.

References


What difference does it make?
A computational model of sameness
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“What’s the difference?” is probably one of the most common questions heard by teachers when students are trying to learn new concepts. Unknown things have a sameness about them, we do not discriminate our actions towards them. In a fundamental sense, to know is to be aware of differences.

This work is about building a computational model of a simple form of abstraction: the classification of a signal as same as, or different from another signal. The ability to detect difference and sameness is fundamental to abstract thinking, and indeed to human thinking in general (Farell, 1985). It is the basis for mathematical equivalence, and is also necessary for language, since a word can be seen as a symbol for things that are somehow the same.

The models were built using the Ikaros framework (Balkenius, Morén, Johansson, & Johnsson, 2010), which provides a way of efficiently setting up system level simulations, and has particularly good support for timing. The core of the models are convolutional self organizing maps, or CSOMs (Balkenius, forthcoming). These can be stacked, and do bottom up organization of inputs. Perceptron networks do supervised learning on temporal differences of the CSOM’s activation, and learn to detect similarities or differences.

Three experiments have been carried out. The first replicates the basic elements of Wright and Katz (2006), where capuchins and pigeons were taught to differentiate between pictures of natural scenes. The results indicate that the model can learn to respond appropriately in less time and with higher accuracy than the animal subjects, and can do so in the presence of random transformations like translation, rotation, scaling, and Gaussian noise.

The second experiment employs the same model as the first, but is given simple letter shapes as input. The magnitude of the aforementioned transformations were also increased. The increase was 66% and 3000%, for scale and rotation, and 50% and 600% for translation in x and y direction respectively. The results indicate that the model performs above chance, but much lower than when transformations have smaller magnitude. It achieved 70% correctness for the larger magnitudes vs. 100% correctness for the smaller ones.

The third experiment adds separate learning units for each of the transformations, to investigate whether the model can learn specific differences. Here, shape is most readily learnt, followed by rotation, while translation and scale have the lowest correctness. Transformations are considered same when they are exactly equal.

What the models actually learn in all these cases are specific patterns of difference. In the first experiment, the perceptron learns to distinguish the relatively small difference in activation due to the image transformations from the much larger difference that occur when two different images are subtracted from one another. The inputs to the perceptrons are matrices which can be interpreted as images. A small difference will leave only a few pixels with high values, whereas a large one will yield several.

The results indicate that the models can make general same/different distinctions, and also that it is possible for them to learn specific differences. These results may contribute to the realization of more complex categorization abilities. Specifically, the models are meant to be integrated with attentional processes to do explicit, or rule based categorization.

References

Online Sexual Grooming and Offender Tactics – What can We Learn from Social Media Dialogues?

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While online social networking sites and other digital media provide a means for positive online experiences, they are also being misused for offences like online sexual grooming. Attempts have been made to analyse and model online grooming in order to understand this kind of predator behaviour (e.g., O’Connell, 2004; Williams et al., 2013). This research, and the resulting models of the grooming process, is however, invariably based on material where adult decoys (e.g., researchers, law enforcement officers, adults trained to entrap offenders) pose as children in the interaction with potential offenders. We argue that such material, i.e., decoy-offender chat logs, does not reflect real grooming processes; Decoys have an underlying agenda to make prosecutable cases against offenders, which entails decoys resorting to manipulation tactics otherwise typical for offender behaviour. In all essence, this often leads to a dialogue with two adults using grooming tactics on each other, and the resulting models do not capture the patterns of child-offender dialogues.

Contrary to previous research, we have analysed real-world child-offender chat logs from closed forums. Our data set, selected dialogues (ca. 500 pages) from a corpus of ca. 12 000 A4-pages was thematically analysed and categorised using NVivo 10 software. The coding was done by both authors for inter-rater reliability. Where coding differed, the authors explored the categorisation until agreement was reached (cf., Whittle et al., 2013). The material was also compared to decoy-offender chat logs (ca. 100 pages, publically available on perverted-justice.com).

The analysis of the different data sets reveal quite different pictures of the grooming process. While previous models describe the grooming process as sequential (O’Connell, 2004) or thematic (Williams et al., 2013), our findings suggest a far more complex behavioural pattern – significantly diverse dialogue patterns with different tactics emerge, depending on whether the respondent is a decoy or a child, and their respective responses. The (preliminary) results show differences in both dialogue and process structure. Dialogues with decoys commonly show what can best be described as “artificial compliance”, presumably due to their underlying agenda of generating prosecutable cases. Furthermore, decoys tease out personal information from the offenders, and also share “personal” information about themselves, even when not asked for it.

Child-offender dialogues instead show patterns of reluctance or objections to offender requests for personal information, suggestions of sexual nature, etc. Another offender tactic is threats to obtain compliance, which was not found in any of the analysed decoy-offender dialogues. Other deviations include differences in dialogue length, number of dialogue turns, and complexity, with regard to changes in topics and offender tactics. Further research is necessary for a more thorough understanding of online grooming, and new models are needed that reflect real-world grooming processes. This includes offender behaviours, reasoning, decisions, and tactics used in grooming. Further, such knowledge is of outmost importance for risk awareness measures for young people so they can better cope with online challenges and risks, and make sensible judgements and decisions in online interactions.

References


Prospection lies at the core of cognition: it is the means by which an agent - a person or a cognitive robot - shifts its perspective from immediate sensory experience to anticipate future events, be they the actions of other agents or the outcome of its own actions. Prospection, accomplished by internal simulation, requires mechanisms for both perceptual imagery and motor imagery. While it is known that these two forms of imagery are tightly entwined in the mirror neuron system, we do not yet have an effective model of the mentalizing network which would provide a framework to integrate declarative episodic and procedural memory systems and to combine experiential knowledge with skillful know-how. Such a framework would be founded on joint perceptuo-motor representations. In this talk we examine the case for this form of representation, contrasting sensory-motor theory with ideo-motor theory, and we discuss how such a framework could be realized by joint episodic-procedural memory.
Decisions in front of a supermarket shelf probably involve a mix of visually available information and associated memories – and interactions between those two. Several cognitive processes, such as decision-making, search and various judgments, are therefore likely to co-occur, and each process will influence visual attention. We conducted two eye-tracking experiments capturing parts of these features by having participants make either judgments or decisions concerning products that had been previously encoded. Half the time participants made their choices with full information about the available products and half the time with crucial task-relevant information removed. By comparing participants’ use of visual attention during decisions and search- and memory-based judgments, respectively, we can better understand how visual attention is differently employed between tasks and how it depends on the visual environment. We found that participants’ visual attention during decisions is sensitive to evaluations already made during encoding and strongly characterized by preferential looking to the options later to be chosen. When the task environment is rich enough, participants engage in advanced integrative visual behavior and improve their decision quality. In contrast, visual attention during judgments made on the same products reflects a search-like behavior when all information is available and a more focused type of visual behavior when information is removed. Our findings contribute not only to the literature on how visual attention is used during decision-making but also to methodological questions concerning how to measure and identify task-specific features of visual attention in ecologically valid ways.