

Animal Computer Interaction Design

Researching dog-centered methods to allow dogs to interact with technology ordinarily

Finding out about Horse-Computer Interaction

In March earlier this year, Steve North published an article on horse-computer interaction '[Do Androids dream of electric steeds?: the allure of horse-computer interaction](#)' as part of his work on HABIT: Horse Automated Behaviour Identification Tool. As someone new to the area of horse-computer interaction, I got in contact with Steve to find out more about the systems he plans to develop and his ethics and methods behind horses in ACI.



HABIT is a Horse Computer Interaction project founded by Dr Steve North and other academic partners



Dr Steve North (photo courtesy of The University of Nottingham)

Hi Steve, lovely to speak to you again! As someone new into Horse-ACI I saw that within your article it was written that 'We usually require horses to interact with us through our technology', could you please explain how currently horses interact with technology? Where is this usually done?

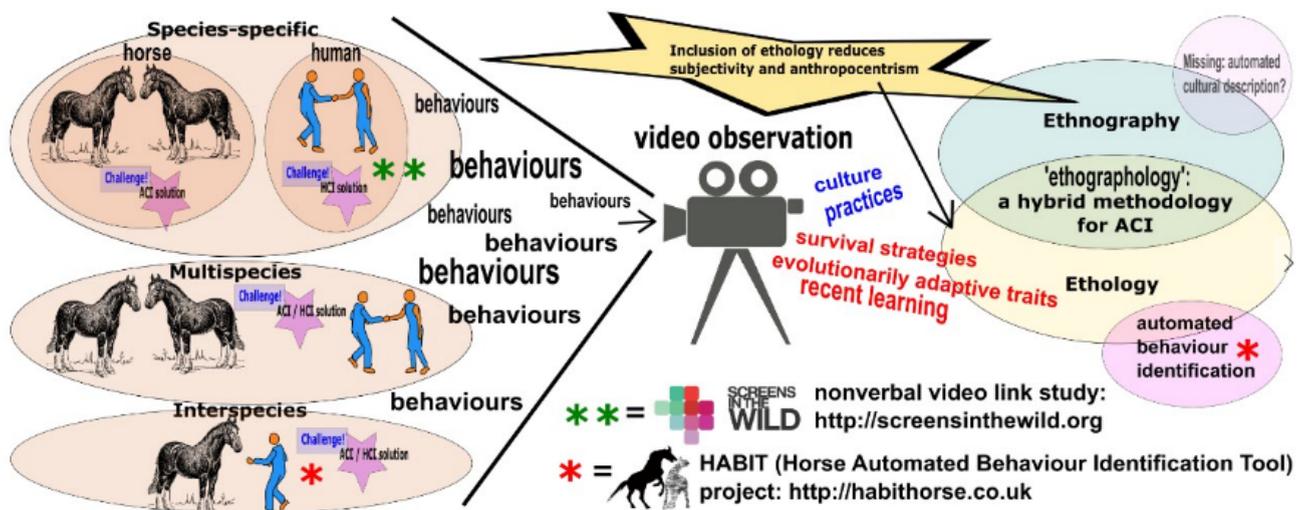
When we (human-animals) first started using horses for transport and for traction (to pull and push objects beyond our own strength and endurance), it was necessary to

control their movement and behaviours. Horses weigh around 500KG and are many times stronger than us. Without the advantage of tool-use, early humans would have struggled to get horses to do anything that they chose not to. At this point, humans had only 'hard' technologies available, such as the harness, the cart and the plough. This was (largely) a one-way conversation. Horses were not asked to enter into these interactions of their own free will. Like dogs, horses are reliant on a social structure, with similarities to that of humans. Whether through choice (grazing nearer and nearer to a human encampment) or via a process of capture and domestication, horses (at the species level) had identified the advantages of partnership (reduced predation, fodder in the winter etc.). For the individual horse, this still may not have worked out very well... Maltreatment, overwork and early death would sometimes have been his or her 'reward' for putting the best interests of the species, before their own. However, once that pact was made, the individual horse had surrendered any notion of consent, when required to interact with our 'hard' technologies. This technological control of horses continues into the present day, wherever horses are used for our entertainment or to labour on our behalf.

Thank-you for that lovely explanation, I really like the link you've made between domesticated working animals and their evolving evolution with us. There seems to be two traps that people can fall into with domesticated animals, both for tool use and an anthropomorphic approach. You touched on this within your article, 'Our current anthropocentric bias denies the reality that human animals are just one species in the family of animals'. How do you think it is possible to reduce this anthropocentric approach? How do you see your technology aiding this and avoiding the pitfalls of human empathy upon image recognition?

Often, it seems that humans are only able to empathise with animal suffering, when they recognise familiar behaviours indicating distress, pain and anxiety. If we can agree what constitutes an animal's (or human's) normal repertoire of behaviours, then the use of automatic behaviour recognition helps to provide an evidence-based approach.

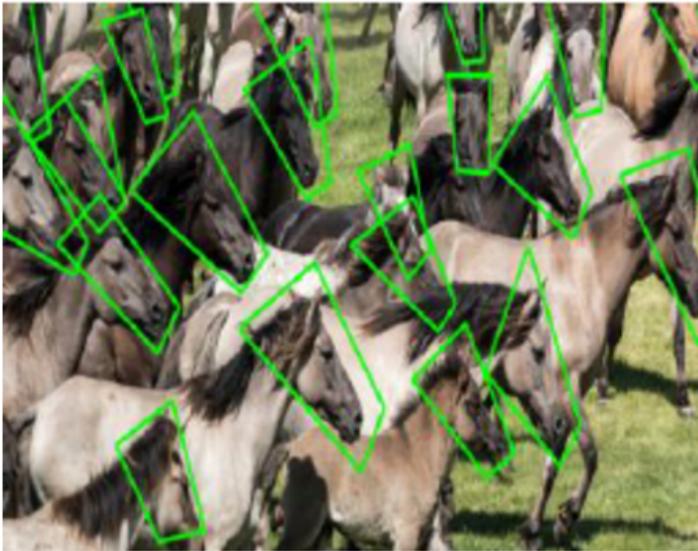
Rather than subjective assessments of animal welfare, we can move towards recognised benchmarks. Cruelty will be harder to justify when we remove the ‘wriggle room’ of humans being able to say things like: “There’s nothing wrong with him, he’s fine!”, or “...that species has a different nervous system to us, it’s not feeling pain in the same way that we do..”. Of course, using current technology to analyse animal behaviour is not the end position. This is just an incremental step. Hopefully, it’s a step heading in the right direction (!).



Poster on HABIT

Automated recognition of behaviour would indeed step away from the human bias, I believe Dawkins (2004) paper suggested accompanying this behaviour with the situations that they want to get to or away from (correlation), such as using this recognition tool to help analyse their likes and dislikes. She does warn over choice analysis though calling it ‘artificial’. This method helps, I believe, to put the animal in the centre of the design by allowing their choices to be the deciding factor enriching the animal. You mention within your work exploitation and enrichment; what is the difference, in your view, of exploitation to enrichment? Who decides the border between the two? The more work I do in ACI the more this question has been highlighted to me, that there appears to be a tension between gathering information for the study vs. the animals’ welfare.

I agree with you that such a tension exists. But it only exists for us... Not



Conceptualised vision of HABIT

for the animal. The animal knows whether environmental changes are appetitive / rewarding, or noxious/ aversive. We (as researchers) may be motivated to delude ourselves as to the benefit of our actions (!). Following on from my last answer, I think that there is a danger in allowing this border to be

subjectively assessed by us as individuals. In our enthusiasm, we run the risk of developing ACI experiences for animals, just because we think that they are interesting. I think that the case for enrichment needs to be made (and proved) on a case-by-case basis. When we intervene in the animal's environment with a new artefact, is this to meet a demonstrable 'need' or a 'want' initiated by the animal? Is there ethological evidence to justify this intervention and have we realistically assessed how our artefact will 'fix' things?

I think though that this tension exists for the animals though when they are deciding to do the study whether or not to give us what we want through compliance or do what they innately choose. I agree with you that it can be interesting to discuss if the product is really for the animal or because we (researchers) think this is interesting. In Sarah Ritvo work (2014), she found that despite making the technology the bonobo apes did not want it, as I have also found with mine. It is this drive to then filter down into the animal's true beliefs that has led to be a biocentric approach to ACI. How did you come to apply the biocentric approach to ACI?

On a personal level, it seems self-evident to me that 'human exceptionalism' is just plain WRONG. Human animals are just not categorically or essentially distinct from non-human animals.



Dr Steve North with Millie the horse

Increasingly, science is also starting to support this position. The erosion of the belief that consciousness is a purely human attribute is a big stride in this direction. In 2012 ‘The Cambridge Declaration on Consciousness’ stated that: “the weight of evidence indicates that humans are not unique in possessing the

neurological substrates that generate consciousness. Nonhuman animals, including all mammals and birds, and many other creatures, including octopuses, also possess these neurological substrates” (Low et al., 2012).

I could not agree with you more; I have had my papers rejected by conferences who have told me that animals do not feel, I believe it was Darwin who first said that ‘there is no fundamental difference between man and animals in their ability to feel pleasure and pain, happiness and misery’. As you know, my work is primarily around dogs, as someone relatively new the area of horses I wondered how ‘The horse was a primary driver of human technological development.’?

Between 4,000 and 3,000 BCE, humans made a distinct transition from eating horses, to exploiting their abilities. Humans had to be able to imagine, design and then implement the technological artefacts required to harness ‘horse power’. As horse transportation then enabled the spatial disbursement of humankind, people encountered new challenges that also required technological solutions, through the same cycle of: imagine, design and implement.

I wonder if dogs go, or have been through this same cycle; in some way I believe they are with their unique ability’s still being ‘harnessed’. In your work you mention physiological ways to track a horse’s level of stress from heart rates to cortisol levels which helps humans understand when a

horse is relaxed. I actually disagree that this being the way forward with monitoring animals and suggest a more triangular system, of behavioural interpretations through owner, the expert and philological signs, which does not rely on approximations which may be biased.

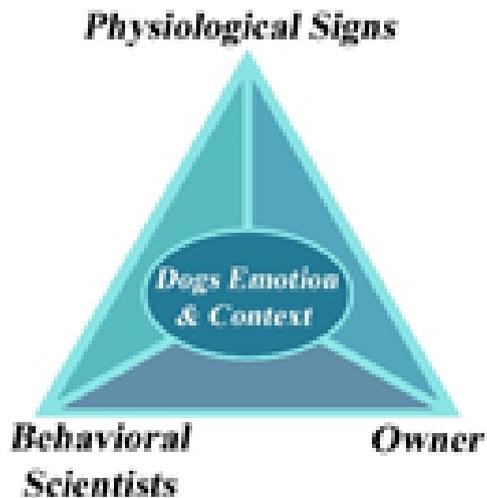


Figure taken from my accepted paper to BHCI'2016 on a triangulation system for measuring behaviour from behavioural scientists observations, owner observations and physiological signals.

For example, the heart frequency can change for varying emotive reasons and cortisol can be for stress or arousal. How do you see your system safe guarding from these? How do you prevent a situation, like in Lawson et al., 2015 work where the human stops listening to their animal and instead goes off technology?

I would prefer stress monitoring to be non-invasive. Humans (at least anecdotally) suffer raised blood pressure as a result of 'white coat syndrome'. How can we expect stress

levels in animals not to be impacted when we start 'doing things to them'? To some extent, this effect (heightened stress caused by 'needle sticking') may be offset through operant conditioning and habituation. Of course, this approach won't work with animals unused to handling, or where habituation to humans is undesirable (say, in a captive breeding program). In equine research, there are methods such as measuring of eye temperature (from a short distance, using infra-red thermography) that have been demonstrated to accurately reflect arousal. I would agree that the reasons for observed physiological changes are sometimes multifactorial. That is why I have a preference for behavioural monitoring. Once an ethogram of behaviours has been refined through trials across a broad sample from a species population, it is fairly safe to link a specific behaviour to fear, as opposed to (say) excited curiosity. It is also possible to combine physiological and behavioural analysis, aiding clarification. My HABIT research partner Carol Hall has combined eye temperature and

cortisol measurements with an ethogram, indicating behaviours relating to ease of horse handling (Yarnell et al. 2015).



Comic about talking horses

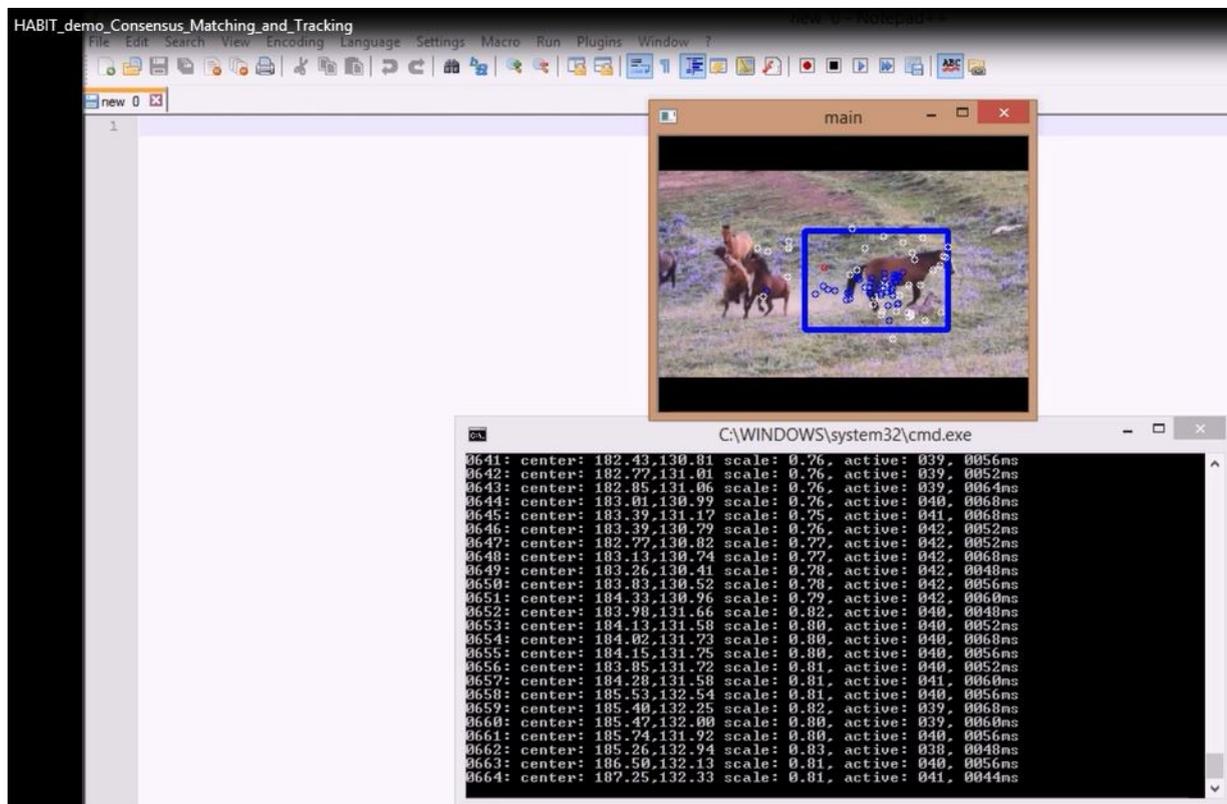
I look forward to seeing such systems! Within your article you mention that 'horses would be unable to provide feedback on its function, ease of us,

and behavioural impact'. Contrary to this, I take the viewpoint that animals are constantly providing feedback through their use, in a similar way non-verbal users do through their body language. You touched on this yourself when you mention that 'perhaps we need to observe and respond to non-verbal behaviors, as we currently do with spoken languages'. As in my doggy ladder of participation model, I believe that through empowering the animal through us changing the feedback method we can learn about their reactions and include them more into the design of the system making it more animal centric. It is in light of this viewpoint that I see it as the humans building bad technology and misunderstanding the animal's own responses that prevents this feedback loop.

Yes, I agree with you totally on this. Animals are expressing their opinions continually. I meant that horses cannot provide feedback using linguistically orientated, speech-based patterns of language. When it comes to providing feedback on an introduced artefact, they are unable to participate in a semi-structured interview (!). Potentially this is very scary to HCI folk...

Hah, I laugh, but in dogs there has been people who have claimed to create systems to allow dogs to 'talk', so maybe this might be done for horses! I think the whole idea of ACI can be scary towards HCI, and I know of those who in fact do not see the link between HCI and ACI at all. As

someone who has been involved in tracking animal's behaviours before I wondered how do you plan on recognising horses within the video? Will this be live recognition of post-recording?



HABIT Horse Tracking Demo

Now, that's a great question, Ilyena 😊 Unfortunately, it's also a question that is as long as a piece of string. In HABIT we have always said that selecting our precise technological approach would form the first work package, in a fully funded research project. As the tech person on the project (along with Clara Mancini from the Open University), I have consistently resisted the temptation to rush into pursuing one approach, without doing a THOROUGH review. Computer Vision is a field where often a great deal is claimed. When it comes to delivery, it is only when you really unpick the underlying algorithms and potential limitations of a solution (...often in the small print...hidden away in a publication) that you *truly* understand its capabilities. However, I have recently been breaking my own rule and started to play around with some code and demos. I'm currently investigating a machine learning-based approach, using template based detectors to recognise movements on video that are characteristic of specific behaviours. This would allow some semantic

connection between an ethogram and templates representing each behaviour. This works on the basis of generalised movements within a video clip. Rather than tracking individual skeletal structure (as with the Kinect), this approach simplifies a behaviour into how it might appear if viewed rapidly out of the corner of your eye. Some neurologists believe that this is analogous to how the human visual system recognises activities, as summarised patterns of movement spotted by groups of ‘trained’ neurons. This all sounds great, but I don’t have anything at a stage that is ready for public consumption. I am still testing out different neural net solutions and thinking about how to classify the results. Too many things to do...not enough time.

In the short term, the HABIT system would be applied to pre-recorded video. I would love this to work in real-time but that may not happen in the early stages. Really ‘hard-core’ computer vision development work is rarely about watching things happen in front of you. It tends to be demanding in terms of computational cycles. It’s more a case of leaving it overnight and coming back to see how five minutes of video have been processed!

It can indeed be how long is a piece of string! I found the more I delved into tracking systems the more a list of flaws and dependencies appeared. I found that in real time the amount of analysis that had to be done slowed down the system and you get better results pre-recorded; Yes it certainly is a case of leaving it overnight at times! Especially if you have a big corpus of learning material.

You mention measuring a horse leading a “natural” life. What would you see as natural? I think this might change between wild horses and domesticated ones, between countries and type of horse (show horse, pet horse, working horse etc.) but I am not a horse expert! How do you plan on tackling problems such as these?

By ‘natural’, I mean within the repertoire of the horse’s behaviours, as described in a well-established ethogram (such as McDonnell, 2003). Yes,



Replica of a horse painting from a cave in Lascaux

there are differences in behaviour according to level of domestication, environment etc. There are also differences at the individual level, which should not be ignored. McDonnell describes the range of behaviours in wild horse herds and then describes stereotypical (abnormal) behaviours and other

behaviours uniquely displayed in a domesticated environment. We plan on starting with the basic ethogram (or even a small subset of it), but refinement or customisation for specific environments / herds / individuals is always possible.

It would be lovely to see how this range of behaviours transcends into real life automated monitoring. I am very interested to see this project as it comes along, as it all sounds wonderful what you are doing: I admire your approach to ACI! I would like to *thank-you* so much for spending the time to talk to me about your work and I look forward to see future publications.

To find out more about HABIT work you can read the [ACM Interactions Article here](#), their position paper on [Horse Automated Behaviour Identification Tool – A Position Paper](#) here or check out their website habithorse.co.uk.

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