Human perception of Quadruped Motion

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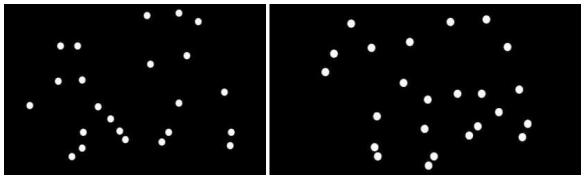

Figure 1: *Example of pig and sheep point-light walkers*

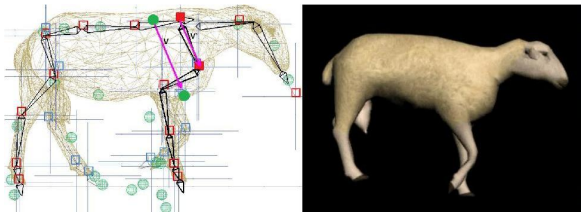

Figure 2: *Retargetting the motion to a 3D model*

In our research we are interested in human sensitivity to differences in animal gaits. We use point light walkers as stimuli, and follow up with a study using a realistic 3D model. Previously it has been shown that humans can regonise human motion, gender and the identity of an actor from a set of moving points [1973; 1977]. McDonnell et al. [2008] show that both shape and motion influence sex perception of virtual human characters. Mather and West [1993] have shown that people can recognise animals from point-light displays. In order to find out whether we can tell the difference between animals using motion cues, we captured the motion of farm animals.

Experiment 1 For every frame of the video, we marked points representing the main joints found on the body and limbs of the animal, enabling us to track the motion of each joint. Using the this data, we animated a set of discs corresponding to the motion from the videos, see Fig. 1. Each point-light video depicted a horse, cow, sheep or pig walking or trotting across the screen for 1 to 3 seconds. After each video, participants were asked to select from horse, deer, cow, sheep, dog or pig. Our results showed that there was a main effect of animal type ($F(3, 30) = 7.7941, p < .01$), where the horse was identified correctly most of the time, followed closely by the pig. The cow and the sheep were identified correctly significantly less often. We found that there was an interaction between the animal and its speed ($F(3, 30) = 3.7061, p < .05$). For the cow it was found that recognition was highest for videos showing the walk gait, whereas for all other animals they were identified more often for the quicker trot, see Fig. 3.

Experiment 2 We used the motion data derived from the point-light walkers to animate a 3D sheep model. Participants were asked to select whether the motion of the 3D sheep model had come from a horse, deer, cow, sheep, dog or pig, Fig: 2. Previous eye-tracking experiments showed that humans tend to observe the upper body far more than the legs of animals and humans [Skrba et al. 2008]. We therefore ran two conditions: full body and legs only. The results for the full body condition are shown in Fig. 4. We applied a two factor ANalysis Of VAriance (ANOVA) with repeated measures, followed by a Newman Keuls post-hoc tests for significance. We found a main effect of response, where the horse was identified correctly significantly more times than any other animal ($F(5, 340) = 9.9082, p < .01$). There was an interaction between gait and response ($F(5, 340) = 33.982, p < .01$). All walking gaits were identified to be from a cow more often than for any other animal. For the trotting gaits, the horse was chosen significantly more times than any other animal except the dog, which was chosen equally often. There was an interaction between animal and response ($F(15, 1020) = 22.824, p < .01$). The horse and the pig were identified correctly significantly more times than any other animal, see Fig. 4. The sheep was identified as a deer significantly more times than any other animal. We also found an interaction effect between gait, animal and response ($F(15, 1020) = 6.3940, p < 0.01$), which was mainly due to participants reacting differently to walking and trotting gaits for the horse, cow and dog. In our leg-only trial a post-hoc analysis using a standard Newman-Keuls test showed that a horse walk was identified as a cow most often, significantly more so than as a dog or pig. Similarly, a cow walk was identified as a cow significantly more so than as a sheep, dog or pig.

	ACTUAL							
	HORSE	HORSE	COW	COW	SHEEP	SHEEP	PIG	PIG
RESPONSE	WALK	TROT	WALK	TROT	WALK	TROT	WALK	TROT
HORSE	54.55	77.28	9.09	31.82	31.82	13.64	0	0
DEER	13.64	13.64	18.18	4.545	27.27	18.18	9.09	0
COW	22.73	0	54.55	13.64	0	4.545	4.545	0
SHEEP	0	4.545	4.545	22.73	18.18	31.82	13.64	9.09
DOG	0	0	9.09	18.18	9.09	22.73	0	31.82
PIG	4.545	0	0	4.545	0	0	54.55	59.1

Figure 3: *Results for Exp1.*

	ACTUAL							
	HORSE	HORSE	COW	COW	SHEEP	SHEEP	PIG	PIG
RESPONSE	WALK	TROT	WALK	TROT	WALK	TROT	WALK	TROT
HORSE	31.16	45.65	21.74	18.48	12.32	28.26	6.884	6.884
DEER	13.77	20.65	11.59	10.14	27.9	27.17	11.59	15.94
COW	35.51	10.14	40.94	5.797	14.13	4.531	26.09	8.333
SHEEP	8.695	11.96	14.13	23.91	20.29	12.68	15.94	19.2
DOG	2.173	6.884	3.623	36.23	7.246	19.93	6.884	20.65
PIG	8.695	4.71	7.971	5.434	18.12	7.971	32.61	28.99

Figure 4: *Results for Exp2.*

References

CUTTING, J., AND KOZLOWSKI, L. 1977. Recognising friends by their walk: gait perception without familiarity cues. In *Bulletin of the Psychonomic Society*, vol. 9, 353–356.

JOHANSSON, G. 1973. Visual perception of biological motion and a model for its analysis. In *Perception and Psychophysics*, vol. 14, 201–211.

MATHER, G., AND WEST, S. 1993. Recognition of animal locomotion from dynamic point-light displays. *Perception 22*, 759–766.

MCDONNELL, R., JOERG, S., HODGINS, J. K., NEWELL, F., AND OSULLIVAN, C. 2008. Evaluating the effect of motion and body shape on the perceived sex of virtual characters. In *ACM Transactions on Applied Perception,*, vol. 5, 21:1 – 21:14.

SKRBA, L., O'CONNELL, I., AND O'SULLIVAN, C. 2008. Eye-tracking dynamic scenes with humans and animals. In *APGV '08: Proceedings of the 5th symposium on Applied perception in graphics and visualization*, ACM, New York, NY, USA, 199–199.

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