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Exploring Interpersonal Judgements between Pedestrians

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ABSTRACT
This paper presents a discussion of the judgements that pedestrians might make about other people when walking after dark, and attempts to evaluate how these judgements may be affected by characteristics of road lighting, primarily the amount of light and the spectral power distribution. Such data are sought to contribute to investigations of design criteria for lighting in residential roads.

Keywords: road lighting, pedestrians, facial recognition, intent.

1. INTRODUCTION

Lighting in residential roads is designed to meet primarily the visual needs of pedestrians and these are enhancement of their safety and perceived safety. One aspect of safety is the ability to make judgements about the intent of other pedestrians - whether or not they present a threat [1].

A basis of current guidance is that lighting should enable facial recognition at a minimum distance of 4m, suggested to be the minimum distance at which an alert subject would be able to take evasive or defensive action if threatened [2]. Past work in the lighting community has hence investigated facial recognition and whether it is affected by the spectral power distribution (SPD) of lighting. Review of the results reveals a mixed opinion, with some studies suggesting SPD affects recognition whilst others do not. Fotios and Raynham [3] suggested that further critique of methodology is needed: in particular, that recognition is not the same task as judgement of intent and therefore that there may be different effects of lighting. Also, the literature does not conclusively support the assumption of the 4m critical distance, and there are clear variations in comfortable interpersonal distances with light level and with the procedure used to measure the desired inter-personal distance [4].

There is a need to highlight that facial recognition is not the only requirement, lighting needs also to aid judgements of the intent of other people. This paper presents two studies carried out to explore interpersonal judgements between pedestrians.

2. INTERPERSONAL DISTANCE AND PERCEIVED FEATURES

A study was carried out to investigate the visual information extracted about other pedestrians at a range of interpersonal distances [4]. An open response task was used in which test participants were instructed to report all the information they could about a target pedestrian, these being photographs of unknown people printed at different sizes to represent different inter-personal distances.

2.1 Method

Four targets were used (Figure 1). These were photographs of four different people on a neutral background; they were standing upright and were asked to hold particular objects. One target was female, three were male; all were aged approximately 20 years old; one male was Chinese, the other three were European. Each target person was asked to hold/wear specific items, for example target 2 held a pair of scissors and target 3 held a knife.

Figure 1 The Four Targets used in Interpersonal Distance and Perceived Features Trials (Target 1 to 4 from left to right).

The aim of the experiment was to determine what features of the targets would be reported at different distances from the test participant: 15m, 35m, 66m, and 135m. The shortest distance (15m) was derived from Townshend [5] who suggested that an interpersonal distance of 15m was required for comfort at night time. 35 m is the distance at which human faces become featureless and 135m is the maximum distance at which we are able to distinguish gender and body gesture under daylight [6]. The 66 m distance was included to provide an intermediate point between 35m and 135m. The targets were observed at constant distance (3.5m) with real distance simulated by target

size. Each of the four targets was presented at all four distances, thus giving 16 target images, and these were printed on A3 size paper.

During trials the laboratory was lit using indirect lighting (6500K fluorescent), with the luminaire placed behind the test participant and aimed toward the ceiling. The wall surrounding the target images was painted white and this had a mean luminance of 1.0 cd/m^2. The luminance of the neutral surround on each image was approximately 0.5 cd/m^2.

Test participants were seated facing the target images (Figure 2). Each trial started with 15 minutes adaptation. Test participants observed four images in sequence: each of the four target images was seen at one of the four target distances, and these were presented in a semi-random order, balanced so that each target image was the first to be presented for an equal number of trials. Participants were instructed to report all the information they were able to provide about the target person and this was done without a time limit. The experimenter recorded which items were correctly reported. Stating (correctly) that the target wore a red jumper would be recorded as a correct response for type and colour of upper clothing, but stating (incorrectly) that the target wore black trousers when they wore yellow trousers would be recorded as a correct response for type of lower clothing but an incorrect response for colour of clothing. A practise image was presented before any trials: this was a photograph of a target person at 15m, but was a different target to those used in trials. The practice trial was carried out to inform participants of the type of information that was sought and to ensure familiarity with the task.

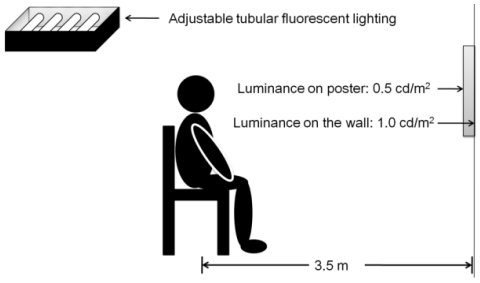

Figure 2 Schematic Diagram of Interpersonal Distance Test

Twenty test participants carried out the test: nine were male; 15 were young (aged 18-34 years old) and five were in the 35-54 age group.

2.2 Results

Reported features were placed into one of 14 categories of features [1)] to enable analysis by the frequency with which each feature was correctly identified during trials. At 15 m most features (except for hair colour, facial expression and facial feature) were mentioned correctly in at least 50% of trials. At 35 m only half of the features were correctly reported in more than 50% of trials, and at 66 m, only gender, hair length, type of lower clothing and build were correctly reported in more than 50% of trials. At 135 m no features were correctly reported more than 50%.

Figure 3 shows the relationship between distance and frequencies by which individual features were mentioned, and these have been grouped according to the apparent trend. For three features (gender, hair length, and build) correct responses were gained at an approximately consistent level of between 75% and 100% for the nearer three distances. It was only at the longest distance, 135 m, that a large reduction was found. For six features (type and colour of clothing on upper and lower body, age group, and shoe colour) there is an approximate linear relationship between log distance and frequency of correct mention and for all six items there is a high frequency of correct identification at the nearest distance. For three features (ethnic group, show type, and facial expression) correct mention at the nearest distance is only approximately 50%, and subsequently decreases to less than 25%. For the final two features (hair colour and facial feature) there was a poor frequency of correct mention at all distances.

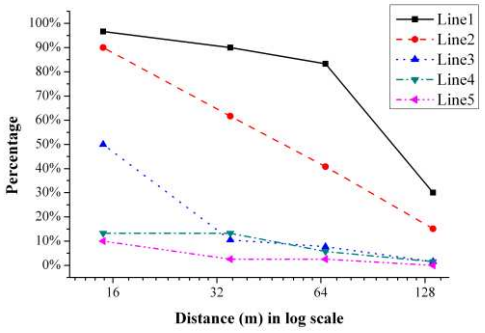

Figure 3 Groups of frequencies of individual features at different distances. (Line 1: Gender/Hair length/Build; Line 2: Type & colour of clothing/Age group/Shoe colour; Line 3: Ethnic group/Shoe type/Facial expression; Line 4: Hair colour/Facial features; Line 5: Knife/Scissors)

These data provide some clue as to what features of other pedestrians might be important and whether these features are distinguishable at different distances.

3. EXPLORING JUDGEMENTS OF THREAT

Past work suggests that visual cues as to intent include facial expression [7] and body posture [8], but the performance of these tasks under low light levels and different SPD is yet to be examined. A problem with evaluation is that judgements may vary within/between subjects, and such inconsistency may confound interpretation of the effect of lighting, if any. Thus a study was carried out to determine the repeatability of judgements of intent based on facial expression or body posture.

There are six universally recognised facial expressions: neutrality, sadness, disgust, fear, anger, and happiness [9]. For body posture there are four recognized postures: anger, fear, happiness, and sadness [10]. Target images were drawn from established databases, these being validated photographs of actors, the FACES database [9] and for body posture the Bodily Expressive Action Stimulus Test (BEAST) [10] database.

3.1 Methods

Test participants were presented with a set of 48 images in random order, these being 24 facial expressions and 24 body postures, and asked to state whether or not the target would be considered threatening if encountered alone after dark. Participants were required to make rapid judgements and this was typically within 2s per image. Participants were asked to repeat this task twice for each target to measure internal consistency, and there was an interval of at least 24 hours between the 1st and 2nd trial for each test participant. All trials were carried out under daylight or office lighting.

For facial expressions there were 12 targets, these being six male and six female, with two each in the young, middle and older age groups. For each target there were two expressions, angry and happy: according to a pilot study these were expected to yield consistent judgements of threatening and non-threatening responses respectively. Figure 4 shows examples of the target facial expressions.

For body posture there were 12 targets, these being six male and six female but of unknown age since target faces are obscured. According to the results of a pilot study, happy, fear and sad postures were selected to present non-threatening targets and angry postures to present threatening postures. Figure 4 shows examples of the target body postures.

Test participants were shown targets and asked to respond whether or not the target presented a threatening situation. Targets were presented on a series of cards, in a randomised order, with one target per card. The size of the targets were chosen to present the images at the visual size at which decisions would be made in real situations, 10 m for facial expression and 30 m for body posture. The twenty test participants included seven females, they were drawn from European, North America and East Asian populations, 18 were young (aged 18-34 years old) and two were in the 35-59 age group.

Figure 4 Sample of facial expressions from the FACES database [9] and body postures from the BEAST database [10]. (1) Young male (identification number 066) with an angry expression; (2) Older female (id. # 079) with a happy expression; (3) Male (id. # M09) with an angry posture; (4) Female (id. # F04) with a fear posture. Note that in the BEAST dataset the targets' faces have been digitally removed.

3.2 Results

Table 1 and 2 show the results of trials for facial expressions and body postures respectively. These are the frequency by which a target was considered to be a threat from the 40 trials (20 test participants x 2 trials). A frequency of ≥30 (≥75%) was considered to present a consistent threat and a frequency of ≤10 (≤25%) was considered to be consistently non-threatening.

For facial expressions it can be seen that happy expressions yield a consistent judgement of not-threat for all 11 targets, with the sad expression giving an inconsistent judgement, and nine of the 12 angry expressions lead to consistent judgements of a threat. Note that neither of the two older female targets with angry expressions was consistently regarded as presenting a threat. For body postures it can be seen that 100% (6/6) of the happy postures lead to consistent non-threat judgements, but this was not the case for the fear and sad expressions. However, the angry postures lead to consistent judgements of threat for only two of the 12 targets.

It seems that the interpersonal judgements of threat based on facial expressions are more consistent than are those based on body postures. This might be partly explained as Ekman [11] suggested that facial expression identifies the emotion while body cues indicate its intensity. Although the simulation distances of facial expression and body posture were not the same in the present tests, they were both clearly presented.

Table 1 Results of threat judgements: facial expression (Note: for target 008 the not-threat expression was sad not happy)

Target facial expression			Predicted NOT THREAT from happy expressions		Predicted THREAT from angry expressions	
Identity number	Gender	Age	Judgements of 'threat' (/40)	Assessment	Judgements of 'threat' (/40)	Assessment
140	F	Y	0	NO	37	YES
069	F	Y	1	NO	36	YES
073	F	M	1	NO	34	YES
122	F	M	2	NO	36	YES
112	F	O	4	NO	29	not consistent
088	F	O	6	NO	22	not consistent
066	M	Y	1	NO	40	YES
008	M	Y	13	not consistent	38	YES
045	M	M	0	NO	32	YES
026	M	M	1	NO	36	YES
015	M	O	0	NO	27	not consistent
059	M	O	3	NO	31	YES

Note: for target 008 the not-threat expression was sad not happy, as this was predicted by the experimenter more likely to be considered non-threatening.

Table 2 Results of threat judgements: body posture

Target Identity number	Predicted NOT THREAT			Predicted THREAT		
	Posture	Judgements of 'threat' (/40)	Assessment	Posture	Judgements of 'threat' (/40)	Assessment
F15	Happy	0	NO	Angry	14	not consistent
F11	Happy	1	NO	Angry	27	not consistent
F26	Happy	2	NO	Angry	20	not consistent
M9	Happy	4	NO	Angry	28	not consistent
M14	Happy	2	NO	Angry	28	not consistent
M08	Happy	5	NO	Angry	18	not consistent
F23	Fear	4	NO	Angry	30	YES
F04	Fear	11	not consistent	Angry	22	not consistent
F19	Fear	12	not consistent	Angry	22	not consistent
M16	Fear	11	not consistent	Angry	26	not consistent
M11	Fear	8	not consistent	Angry	20	not consistent
M17	Sad	22	not consistent	Angry	34	YES

4. CONCLUSION

A primary interpersonal judgement is the intent of another pedestrian on the road. While facial expression and body posture are stated to provide cues to emotion, and thus intent, the current study suggests that the standard expressions/postures do not map directly to intent judgements. This means that investigation of lighting effects needs to be cautious.

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