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„Nonverbal Behavior in Public Space
as a Function of Density and Group Size“

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I. Introduction

Where I stand or sit or look is available to all who see me; I cannot keep it hidden. Spatial behavior is communicative. If I move toward you, or away from you, or even if I stand still, my behavior is available as a message. And, it is a message about me, about you, and about us. Whether a person's location was planned or accidental, strategic or expressive, interpreted by others as inconsequential or meaningful, it is exposed and available for any of these inferences. (Knowles, 1989, pp. 53-54)

A person is always in interaction with its environment. Every aspect of the environment is important, but some kinds of information, particularly those related to self preservation, are needed more than others. The perceived safety refers to the level of comfort and depends on different conditions according to the setting. I want to examine perceived safety expressed through nonverbal behavior. One category of nonverbal behavior, the 'auto manipulators', is associated with anxiety, discomfort and stress (Ekman, 1977; LeCompte, 1981; Rosenfeld, 1966) which means that they are good indicators for perceived safety.

My diploma thesis is part of an EU funded project, called *Vanaheim*¹ which supplied me with video material collected in one European city. The main part of my study was the observation of the behavior of people in the ticket hall of selected metro stations. The behavior of people was coded based on surveillance videos from these metro stations and I evaluated this data according to occurred auto manipulations, depending on different conditions. I assumed that the perceived safety in the ticket hall of the metro stations depends on the density of people present and on the companionship of a friend.

¹ Video/ Audio Networked surveillance system enhancement through Human-centered adaptive Monitoring, a large-scale integrating project (n°248907). The project's goal is to make surveillance material applicable for conflict or crime prevention. Therefore a tool should be developed based on visual and auditory cues that can help securities detect unusual behavior.

1. Nonverbal behavior

Charles Darwin (1872/1965) started the empirical study of nonverbal behavior. He introduced several major substantive and theoretical issues and pioneered some methods of research. One issue concerns the question if nonverbal behavior is inherited or socially learned. Darwin was convinced that facial expressions are biologically determined and that there is a phylogenetic continuity in their evolution, but did not deny the strong effect of culture and social structures. Darwin confirmed that some nonverbal behaviors, specifically symbolic gestures, function as communication, although innate facial expressions did not originate in a need of communication.

The study of body language and its interpretation is also called kinesics (Birdwhistell, 1971). Systematic research about kinesics began more than half a century ago, but there was a lack of development in strategies for coding and recoding body movement. This could be a consequence of the wide range of foci and methodologies, defined by many researchers from different disciplines. The lack of coordination and the state of disjointedness makes it difficult to compare different studies and to develop a theoretical framework for understanding body movement. (Harrigan, 2005)

Harrigan (2005) divides his present discussion about methodological issues concerning body movement in two segments: Body positions and body actions. The body actions are expressive movements which are supported by position behaviors. Body positions include overall postures, trunk lean, trunk orientations, arm, leg and feet positions as well as postural shifts (Harrigan, 2005). Ekman and Friesen (1969) outlined a coding system which includes five categories of nonverbal behavior: Emblems, illustrators, regulators, affect displays and adaptors. These are the most frequently used categories for coding body movements, especially hand movements. I explain them briefly at this point and elaborate on adaptors in chapter 2 because they are the focus of my research.

Emblems

Ekman and Friesen (1969) previously defined this type as gestures, but since this term is too inclusive in common usage, they substituted it with emblems. The word emblem was first used by Efron (1941/1972) who conducted a study of gestures depending on race and culture. An emblem differs from other nonverbal behaviors in its relationship to verbal behavior and its awareness and intentionality. The direct verbal translations of emblems are well known by

all members of a group, class or culture and they originate mostly through culture-specific learning. Emblems are primarily shown by face and hands and are simple to understand. (Ekman & Friesen, 1969)

Illustrators

Illustrators are described by Ekman and Friesen (1969) as “movements which are directly tied to speech, serving to illustrate what is being said verbally“ (p. 68). They can repeat, substitute, contradict or augment the information, that is provided verbally. The use of illustrators occurs with the same or maybe a slightly smaller awareness and intention than the use of emblems. Efron (1941/1972) explained that there are types of illustrators which have no independent meaning or connotation from the speech and also types of illustrators which have a meaning which is independent of the speech. Illustrators are socially learned, often through imitation, and their usage vary with ethnic background.

Regulators

Ekman and Friesen (1969) explained that regulators “maintain and regulate the back-and-forth nature of speaking and listening between two or more interactants” (p. 82), like nods, postural shifts, eye contact and utterances such as ‘mm-hmm’. Regulators can tell the speaker to hurry up, continue, repeat, become more interesting, *etc* and can tell the listener to pay attention, to talk, to wait, *etc*. They occur on the periphery of awareness, which means that a person can perform them without knowing, but if asked they can recall and repeat it. (Ekman & Friesen, 1969)

Affect Displays

This category primarily refers to the face. “There are distinctive movements of the facial muscles for each of a number of primary affect states, and these are universal to mankind” (Ekman & Friesen, 1969, p. 71)

Adaptors

The last category of nonverbal behavior, explained by Ekman and Friesen (1969), is called adaptors. Ekman and Friesen use this term, because they believe that the adaptors were learned in childhood as a part of adaptive effort for obvious reasons, for example to satisfy bodily needs. But when these actions are used in adulthood, habitually and without awareness, only a fragment of the original adaptive behavior can be seen. The original function is no

longer clear. Self adaptors are body movements, where one part of the body does something to another part of the body, for example scratching the arm or picking the nose. Object adaptors occur in similar circumstances and are movements like playing with a pencil or scratching the ear with a paper clip (Ekman, 1977). Ekman and Friesen (1969, 1972) began their study of body movement in 1954 and used first the term ‘self adaptors’ but switched later to the term ‘body manipulators’, not because they abandoned their theory about the adaptive origin of these actions but because they thought that this phrase was too theoretically charged (Ekman, 1977).

2. Auto manipulators

The terms used for body manipulation movements within the nonverbal behavior literature is very confusing, because there are different labels for this category of nonverbal behavior (listed in Table 1). The definitions for this term are more or less the same.

Table 1: A number of different but related classifications of hand movements.

Author and Year	Terminology
Rosenfeld (1966)	Self manipulation
Freedman and Hoffman (1967)	Body-focused movements
Ekman and Friesen (1969, 1972, 1977)	First self adaptors, then body manipulators
Knapp, Hart and Dennis (1974)	Self adaptors
Stokols, Smith and Prostor (1975)	Self manipulation
Le Compte (1981)	Hand-to-body-or-face movement
Ruggieri, Celli and Crescenzi (1982)	Self-contact gestures
Harrigan (1985, 2005)	Self touching and self adaptor
Renninger, Wade and Grammer (2004)	Auto manipulations

In this diploma thesis I will use the term ‘auto manipulators’, which includes not only self adaptors, but all self directed body focused movements, such as rubbing the face, scratching or playing with one’s hair. I code every movement in which one hand does something to

another part of the body as an auto manipulation, like touching the face, putting one finger in the mouth, picking one's nose, touching the head, holding one hand in front of the face, touching the upper body and adjusting the hair.

By combining all definitions it can be said that auto manipulations are often excluded from the context and have a lack of true functions (Ruso, Renninger, & Atzwanger, 2003). Auto manipulators produce sensory stimulation and are performed to relieve self or bodily needs (Ekman & Friesen, 1974). They are excluded with little or no awareness (Ekman, 1977), but with regularity and at specific points of interaction (Harrigan, 1985). They usually are not used to occur to communicate, although they convey diffuse informations. The occurrence of auto manipulators influence how a person is perceived. Observers characterize people who show many auto manipulation actions as awkward, tense, anxious, ill at ease and untrustworthy. (Ekman, 1977) The absolute frequency of auto manipulators varies from individual to individual, but they increase with discomfort and are a characteristic of approval avoiders (Rosenfeld, 1966). They are responsible for some inner processes and because of the stimulation of sensory nerve endings auto manipulators function to modify sensory experiences. This means that they can relieve or intensify the state of body tension (Freedmann, 1972). Auto manipulation rates are higher in stressful settings than in relaxed settings (LeCompte, 1981), which leads to the suggestion that auto manipulations act as a stress-reducing mechanism (Stokols, Smith, & Prostor, 1975). Auto manipulators can also help to distinguish between deceivers and non-deceivers, because of the mannerism of showing self-touching due to nervousness (Knapp, Hart, & Dennis, 1974). Close proximity to unknown companions increases the frequency of auto manipulations (Givens, 1987).

As a summary it can be said that auto manipulators are associated with anxiety, guilt, discomfort, conflict or underlying negative affect, hostility, suspiciousness and stress, deception and closer proximity between participants.

Stokols, Smith and Prostor (1975) examined under which conditions density or people affects human behavior. They observed waiting people in an office of the California State Department of Motor Vehicles, The experiment incorporated three different levels of partitioning: Minimal partitioning (no room dividers), moderate partitioning (ropes and standards) and high partitioning (solid wooden partitions). The frequency of self-manipulations were the index of behavioral tension. "Self-manipulation was defined as the touching of some part of the body or an article worn on the body (e.g., glasses) with one's hand" (p. 801). Results showed that subjects in the partitioned conditions exhibit the highest level of self-manipulation while subjects in unpartitioned conditions manifested the least. The

results showed that men displayed more self manipulations than women. Stokols, Smith and Prostor explained, that women felt particularly uncomfortable upon entering a maze of large partitions and that this discomfort was manageable in the context of short-term and non threatening nature of the situation.

3. Public Space

There are special behaviors in public spaces, like public order rules of conduct. Goffman (1963) explains that the public order is traditionally defined and refers to the regulation of face-to-face interaction between those people who are not well acquainted. Public spaces refer to any freely accessible locations, for example streets, parks, restaurants, theaters, shops, dance floors, meeting halls and other gathering places of any community (Goffman, 1963). In all public places written or unwritten rules exist, for example regions where persons of certain status are forbidden to enter. These rules of trespass are well known for private places, contrary to many rules which limit the right for every person to be present in open, unwallled public places, for example the rules about late-hour presence on town streets for youth below a certain age. Unwritten rules of behavior are common to all settings and situations and are exclusive to them. Goffman (1963) names these rules 'to fit in'. Participants have to be 'good', not arouse undue attention and not cause a scene or disturbance. But what is proper in one situation may certainly not be proper in an other.

Every public space is a setting were different forms of interaction between individuals in each other's presence can be seen. The full conditions of *copresence* are, that the "persons must sense that they are close enough to be perceived in whatever they are doing, including their experiencing of others, and close enough to be perceived in this sensing of being perceived" (Goffman, 1963, p. 17). This means that the individuals become available, accessible and subject to one another. These conditions occur only in particular settings, such as in waiting rooms. On public streets the areas in which mutual presence can occur are very complex, because persons who are able to observe people, may be unobservable by them, but by a different set of people.

A persons' behavior depends on specific setting. Barkers (1968) *behavior setting theory* explains that different people act more similar in the same environment than one person does in various environments. Barker defines behavior settings as naturally occurring, temporally

and physically bounded behavior-milieu-interfaces. Behavior settings have very urgent influences on behavior and the influences of behavior settings are often stronger than individual differences.

Goffman (1963) explains that some parts of the behavior in public spaces are very well examined, such as riots, crowds and panics but the study of ordinary social contracts are not. The perception of a public space is depending on everyone's personal space.

4. Density

Personal space, the personal immediate space around one's body, focuses on the societal use of personal space, comfortable interpersonal distances and self-protection from violation. This invisible boundary functions as a comfort zone where negative and emotional reactions occur when violated (Dosey & Meisels, 1969). If there is enough space, individuals choose to navigate around rather than violate others' personal spaces, whether they are individuals or in groups. Stress occurs when one's personal space has been violated and people are also uncomfortable when violating personal space between two conversing people or the interpersonal space in a group (Cheyne & Efran, 1972). Knowles (1979) mentioned that the proximity between the people is an indicator for the perceived density.

Stokols (1972) defined the term density as the physical condition which involves spatial limitation. Spatial limitation involves potential inconveniences, like the preclusion of privacy or even the restriction of movement. Paulus (1980) defined two terms of density for natural environments. The social density, which is the number of participating individuals and the spatial density, which is the average space available for each person. This description allows to describe the density of individual settings, to compare settings and to bring this terminology into line with that of other fields (Freedman, 1979).

Rapoport (1975) explained a model for affective density (Figure 1), which implies that the affective density is the judgment or evaluation of the perceived density against certain norms, standards and desired levels of interaction and information. The perceived density is the perception and estimation of the number of people present in a given area and the available space.

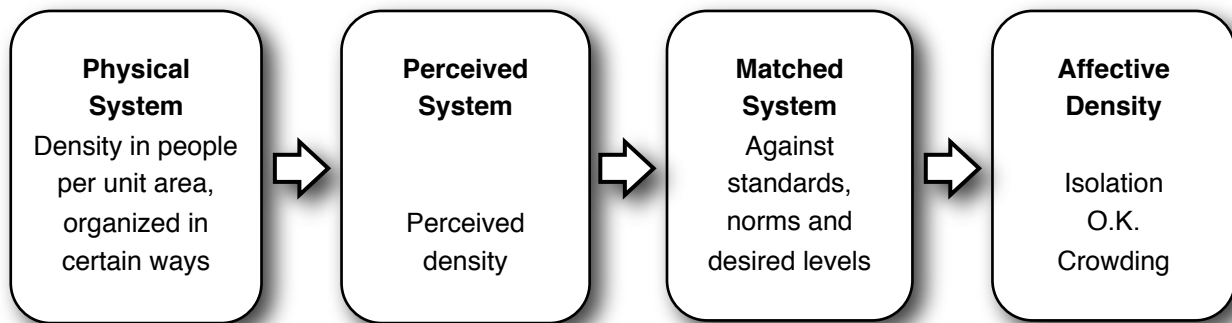


Figure 1: Model for affective density (after Rapoport, 1975)

Sommers (1969) studies showed that a person is less tolerant of the presence of another person when the other is approaching or facing him. The emotional reaction to the approach of another person is greatest when the approach is from the front, less from the side and the least from behind. If the approaching person is of the opposite sex, it is also stronger (McBride, King, & James, 1965). The affective consequences of spatial invasions depend on the sex of the subject, the sex of the invader and the spatial position. It is more negative when the invader is of the opposite sex. Females express more negative affects than males when the invader is adjacent. Males express more negative affects than females when the invader is face-to-face (Fisher & Byrne, 1975). The expressions of negative affects also depend on the companionship of another person.

5. Group

In keeping with the approach advanced by Brodbeck (1958) and Lewin (1948), Cartwright and Zander (1968) give a definition to identify the broad class of social entities commonly referred to as groups:

A group is a collection of individuals who have relations to one another that make them interdependent to some significant degree. As so defined, the term group refers to a class of social entities having in common the property of interdependence among their constituent members. (p. 46)

Bales (1950) studied particularly the interaction of small groups and defined a small group ...

... as any number of persons engaged in interaction with one another in a single face-to-face meeting or series of such meetings, in which each member receives some impression or perception of each other member distinctive enough so that he can, either at the time or in later questioning, give some reaction to each of the others as an individual person, even though it be only to recall that the other was present. (p. 33)

Cartwright and Zander (1968) combined many definitions of groups and provided a list of important features of groups:

It seems likely, that when a set of people constitutes a group, one or more of the following statements will characterize them:

- (a) they engage in frequent interactions;
- (b) they define themselves as members;
- (c) they are defined by others as belonging to the group;
- (d) they share norms concerning matters of common interests;
- (e) they participate in a system of interlocking roles;
- (f) they identify the same model-object or ideals in their super-ego;
- (g) they find the group to be rewarding;
- (h) they pursue promotively interdependent goals;
- (i) they have a collective perception of their unity;
- (j) they tend to act in a unitary manner toward the environment.

... The larger the number of these attributes possessed by a set of people, and the greater their strength, the closer the collection would seem to come to being a “full-fledged” group. (p. 48)

Zander, Stotland and Wolfe (1960) suggested that the fact of membership affects anyone who belongs to a particular group. The stronger the ‘group character’ of the set of individuals constituting the group is, the greater the effects of membership on an individual are. They found out, that a group member is meant to be ‘in’ the group and to be located within its boundaries.

Personal space is defined as a bounded, protected and moveable territory that every person carries into social settings (Sommer, 1959). Small interactive groups occupy an interaction territory which “implicitly makes the claim of boundary maintenance for the duration of the interaction” (Lyman & Scott, 1967, p. 240). This bounded social space describes the relations between a small group and its social environment perfectly. Members of a dyad protect their common social space against an invader. Knowles (1972) found that pedestrians avoid walking through the social space of an interacting group. This social space boundary acts as a buffer zone which keeps people away from the interaction. The extension of the boundary around a group increases with the size of the group (Knowles, Kreuser, Haas, & Hyde, 1967). Individuals, groups, collectivities and crowds (social units) are bound entities which influence others in the setting and are influenced by others. They vary in the amount of space they occupy and in their attraction or repulsion of other units. (Knowles, et al., 1967)

Baum, Harpin and Valins (1975) focused in their research on the role of group phenomena in the crowding process. They defined groups as social structures which have the capacity to mitigate harmful or aversive effects of high density and reduce the likelihood that group members experience crowding like non group members. Because of these boundaries group members are shielded from many unwanted interactions from outside the group, which means that group members are less susceptible to unwanted and inappropriate social encounters. The regulation of social experiences is reinforced by the norms established by the groups, therefore they are less likely to lose control over these experiences.

6. Coding

In all researches where individuals are observed, like studies of personal space or studies of group phenomena, an exact planning of the studies' method has to be done.

David Efron (1941/1972) conducted a study, which is one of the best studies in the field of nonverbal behavior (Scherer & Ekman, 1982). Efron examined the gestures of Jewish and Italian immigrants in New York using naturalistic observation and some experimental induction. He was one of the first who used video taping extensively to document sequences of nonverbal behavior and he used the frame-by-frame analysis methods, which have become important for nonverbal analysis.

In the fifties and sixties psychiatrists and clinical psychologists had a strengthened concern in nonverbal behavior, which resulted in the foundation of many new methods and approaches.

Before recording behavior, two levels of decision have to be made: Which subjects to observe and when (sampling rules) and how to record the behavior (recording rules) (Martin & Bateson, 1986). The *sampling rules* cover the distinction between ‘ad libitum sampling’, ‘focal sampling’, ‘scan sampling’ and ‘behavior sampling’. ‘Ad libitum sampling’ means that the observer notes whatever he sees and whatever seems relevant to him. ‘Focal sampling’ means that one individual is observed for a specific amount of time. All instances of this individual’s behavior are recorded in different categories of behavior. This is generally the most satisfactory approach for studying groups. ‘Scan sampling’ means that a whole group of individuals is scanned at regular intervals. The behavior of each subject at this moment is recorded. This method restricts the observer to record only few simple categories of behaviors. ‘Behavior sampling’ means that the whole group of individuals is watched and every occurrence of a particular type of behavior is recorded. The *recording rules* cover the distinction between continuous recording and time sampling. ‘Continuous recording’, also called ‘all-occurrences recording’ means that each occurrence of the behavior pattern is recorded, together with the information about the exact time. ‘Continuous recording’ preserves more information about a given category than ‘time sampling’ which means, that the behavior is sampled periodically. (Martin & Bateson, 1986)

Scherer and Ekman (1982) illustrated that every scientific research requires representative sampling of the objects of interest, because only a limited number of people and only a small part of their behavior can be studied in a limited number of settings. Researchers have to face some important questions, such as which behavior to study, where to study the behavior, who to observe, how to conduct the observation, how long to let the observation last and which aspects of the behavior to note. This research can be done in the *field* or in a laboratory. Scherer and Ekman (1982) explain that the term *field* is used by social scientists to refer to the typical settings of human behavior. This can be applicable to all social settings in which daily behavior is situated, such as public places, interiors and schools. “The field is any setting that is not a laboratory” (Scherer & Ekman, 1982, p. 16). The choice between laboratory and field depends on the nature of the asked question and the interest of the researcher. In this content a discussion about naturally occurring versus artificial behavior often occurs. Artificial behavior can be found often in laboratory and field. It happens because people as soon as they know

that they are observed behave differently than they would naturally behave (see the studies reviewed in Ekman & Oster, 1979).

The question of how many people to study is very important, because only a limited number of people can be practically studied. Therefore compromises are required. The available resources should depend on at least two considerations: “The question being asked and the generalization being sought” (Scherer & Ekman, 1982, p. 23). The researchers have to think about the type of person as well as on the number of persons whose behavior is observed. They have to be careful about generalizing from the observed sample to the population as a whole, especially if a specific group has to be observed.

The rich mosaic of actions, gestures and postures of a human body makes the feasibility of coding body movement difficult. Harrigan (2005) explains three key factors which facilitate the coding of body movement. The first one is the modest number of moveable body parts, which means that not all parts of the body are involved in movements of positioning the body. Body positions involve movements of the legs, limbs and the trunk. The limbs receive the most attention in social encounters. The second key factor is the behavioral repertoire limitation, which explains that of all possible actions and positions a body is able to perform anatomically some actions rarely, if ever, occur. The third key factor is the co-occurrence of behavior, which means that body movements can be displayed simultaneously or in sequence. When two movements have a temporal relationship to each other, it is easier for a coder to see them.

There are some main differences between the coding of body actions and body positions. Body actions have a relatively clear onset point, the beginning of an action, and an offset point, the end of an action. These body movements can be performed by the head or the limbs, like nodding, kicking or gesturing. Body positions include overall postures (like sitting, standing or lying), trunk or frontal orientations, trunk lean as well as arm and leg positions (like folded arms, or uncrossed legs). While body actions are considered as expressive movements, body positions are always present. (Harrigan, 2005)

7. Research question

The aim of this study research is to investigate whether individuals who feel safe perform less auto manipulations than individuals who don't feel safe, because auto manipulators are associated with anxiety, discomfort and stress (Ekman, 1977; LeCompte, 1981; Rosenfeld, 1966). The perceived safety in the ticket hall of a metro system depends on the attendance of the people present in the ticket hall, because people get uncomfortable when their personal space is violated (Cheyne & Efran, 1972). Therefore I expect that more than nine and less than two visible people decrease the perceived safety. Group members feel safer than non group members independent from the number of visible people because a the social space increases with the size of the group (Knowles, 1972). This social space is a protected and moveable territory that every person carries into social settings (Sommer, 1969)

This leads to the hypotheses:

- I. If the focused person is a member of the group, he or she will perform less auto manipulations than persons who are not members of a group.
- II. If the density of people present in the ticket hall is less than two or more than nine persons, the focused person will perform more auto manipulations than if the density of people present lies between two and nine persons.
- III. I want to take an explorative look at the other behaviors in metro stations with the context of the size of the group and the density of people.

II. Study Methodology

1. Material

The material consists of audio-video-data recorded in June 2007 and September 2007 in six metro-Stations of one European city. All the stations share the same infrastructure layout, but they differ in the density of people passing by. The station called ‘DOD’ is the main station of this system and is connected to the railway station of this city.

The recording time varies from 7 a.m. to 9 p.m.. Every station contains the following settings: Ticket hall, entrance areas, escalator, stairways, elevator and station platform. For my study I focus on the videos recording in the ticket hall (the green area in Figure 2), because in the ticket hall the people are relatively unrestricted in their behavior. Furthermore different settings can lead to different behaviors, according to Baker’s (1968) behavior setting theory, which explains that an individual behavior is better explained by their current environment than by the individual characteristics. Because of this I focus only on one setting: The ticket hall.

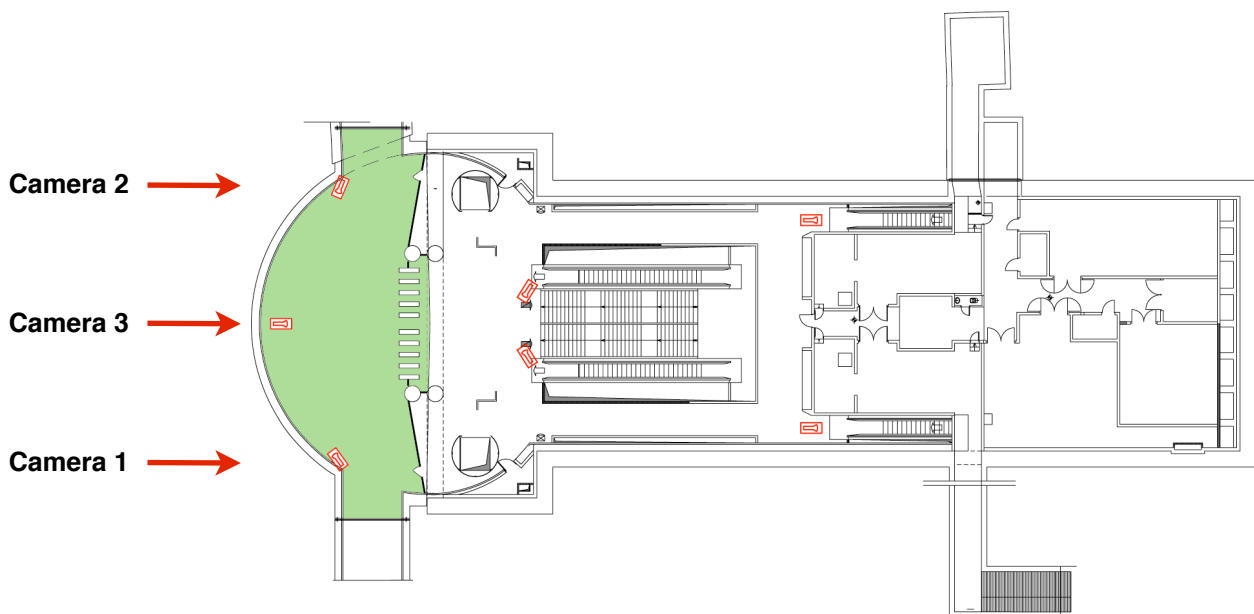


Figure 2: A detailed plan view of the entrance level, including the ticket hall. The green area is the place of interest. The red arrows show the three cameras.



Figure 3: Screenshots from the three different camera perspectives. Picture A shows a screenshot from a video recorded of camera 1. Picture B shows a screenshot from a video recorded of camera 2. Picture C shows a screenshot from a video recorded from camera 3.

The ticket hall is recorded from three different perspectives. The camera placements are shown in Figure 2 and in Figure 4. For analysis I use one main perspective, the other two are used to give assistance to discern the behavior of the focused person, which is a considerable advantage.

All data are encoded in MPEG-4 with a resolution of 704x228. All data are recorded 5 frames per second (fps).



Figure 4: The recording camera and its placement in the ticket hall.

2. Methods

2.1. Procedure

I coded the focused persons from the time he or she is entered the ticket hall to the time he or she left the ticket hall. In this specific time I coded every occurred behavior exactly at the time it happened ('focal sampling rule' and 'continuous recording'). Therefore I developed a behavior catalog, which contains a great amount of possible behaviors in metro stations. Before I started the coding I checked the reliability using *Cohens'* Kappa. I coded two persons twice and compared the data, which delivered a Kappa value of 0.97.

I coded every applicable person from the age of the adolescence to the estimated age of 60 years. In the end, to get comparable data, I searched particularly for people in a group or within a high (ten and more) or low (less than two) density of human beings. I used a free annotation tool, ANVIL© 5.0 (Kipp, 2001, 2010). The outcome was imported in a statistic program for analysis. The measurements contain how long the focused person was observed, which behaviors occurred and for how long these behaviors occurred (frequency and duration).

For a better picture of the ticket hall and the persons behaviors i explain briefly a 'usual' walk through the ticket hall. There are three different possibilities:

- (1) The persons are coming from the entrance into the ticket hall and are walking towards the barrier which allows only people with a valid ticket to access the metro platform. Most of them are carrying a bag or other objects. Some of them are looking in their bags for the ticket, others already have their ticket in their hand at the time they are entering the ticket hall. They stand still or move in front of the barriers and put the ticket into the machine. If the ticket is valid, the barriers open and the persons can walk through. Some of them walk in groups.
- (2) The persons are coming from the entrance into the ticket hall and are walking towards the vending machine (which is placed opposite the barriers). They buy their tickets and subsequently walk towards the barrier. Most of them are carrying a bag or other objects. They stand still or move in front of the barriers and put the ticket into the machine. The barriers open and the person can walk through. Some of them walk in groups.
- (3) The persons are coming from the metro platform and are walking through the barrier. They are walking towards an exit, mostly carrying a bag or other objects. Some of them walk in groups.

2.2. Behavior catalogue

To be able to examine the hypotheses it is inevitable to get an overview of the entire behavior spectrum in the given context. A catalogue denotes a portion of an animal's or human's repertoire, which includes all the behaviors that are capable of performing. This description should inform others of our observations in an objective way without bias to our own experiences or personal beliefs. The behaviors are divided into categories, which have to exclude each other. Lehner (1979) called them *mutually exclusive behaviors*. They may not occur at the same time, because it wouldn't be possible to code them, if an individual showed them at the same time. If there are two categories of non mutual behavior they have to be pooled or discarded. (Lehner, 1979)

To observe the behavior in the ticket hall of a metro station I developed, with the help of other students, a behavior catalogue. This should cover all possible behaviors, which can be performed in the ticket hall of a metro station. We had to make restrictions because of the available video material. The videos' resolution was limited, hence we had to focus only on applicable and clearly identifiable behaviors.

The behavior catalogue consists of 14 umbrella terms, named tracks with mutually exclusive categories in each track. At this point I describe the tracks which are important for my analyses. The whole behavior catalogue can be found in the appendix. The first tracks describe general information about the observed person: Sex, size of the group, age and setting.

The track *size of the group* describes if the focused person is alone or within a group (see also Figure 5). Based on the study of Costa (2010) we can identify groups by walking speed, group formation and interactions between the group members. His research shows that groups comprised of more than three individuals tend to split themselves up into singles, dyads and triads. I use this knowledge to identify groups.



Figure 5: Screenshot from a video where three different groups are seen.

The task *density* explains the counted number of people who are visible at the same time as the focused person. It is divided into three categories: Less than two, two to nine and more than nine (for a better understanding, see Figure 6). These categories came up during the ‘ad libitum’ observation. If more than nine people are present at the same time, the personal space has to be violated at some time. Since the persons are walking in different directions through the ticket hall people approaching other people, thus increases the level of discomfort (Sommer, 1959).

The track *setting* explains which camera shot is mainly used for the coding of one person’s behavior.

Locomotion and posture describes the movement and the overall postures of the focused person. The categories are to stand, to walk, movement not straight forward, to run, interruption of the movement, bended posture and to sit. If the person is carries a bag or a

backpack on the shoulder, this is coded in the tracks *shoulder right* and *shoulder left*. *Right limb* and *left limb* contains many movements with the limbs, such as arm swings free, auto manipulation, primping, manipulation of moving objects, manipulation of metro equipment, to carry and to gesticulate. Further tasks describe the behaviors in the *face* (for example to eat or drink, to talk, to laugh or to phone) and the *gaze direction*.



Figure 6: Screenshots from the three different times of interest. Picture A shows a screenshot from a video with low density (less than two people). Picture B shows a screenshot from a video with moderate density (two to nine people). Picture C shows a screenshot from a video with high density (more than nine people).

2.3. The annotation tool

I used ANVIL© 5.0 (Kipp, 2001, 2010), a free video annotation tool, written in Java and for Windows, Linux and Mac. It was developed for video analysis of gesture research and offers multi-layered annotation based on a user-defined coding scheme. The tool allows to code information about events in the video systematically and efficiently and to view and analyze these codings. The general goal of this annotation tool is to support the process of adding annotations for a particular video. The ANVIL user interface contains four windows (displayed in Figure 7).

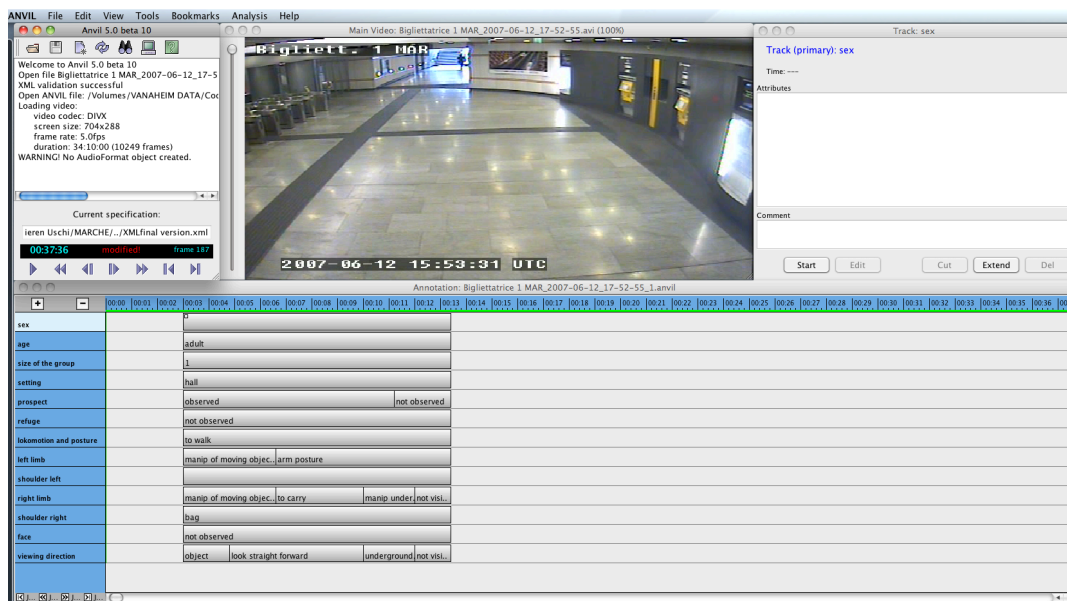


Figure 7: Screenshot from the ANVIL (Kipp, 2001) user interface during the coding of nonverbal behavior.

The upper middle window displays the video. It is also possible to play a set of synchronized videos which show the same session from different angles. The upper left window provides details of program execution and playback controls including variable playback speed and single-frame movement. The upper left video gives information about the currently selected track and annotation element. The so called *annotation board* is the main window at the bottom. The horizontal dimension is time, in units of video frames, and the vertical dimension is a collection of *tracks*, each containing its own user-defined annotation type. A vertical playback line is running across all tracks, and it is synchronized with the current video frame. The video fast-forwards and rewinds if the playback line is moved forward and backward, and vice versa. As a user, you have to click on a track at the starting frame of an interval of interests and mark an ending frame of the interval to create a new

annotation. Figure 4 shows a finished observation of one person. The boxes on parallel tracks along a horizontal timeline visually represent an event's duration. These boxes contain predefined information like sex, size of the group, setting or gaze direction. ANVIL fulfills important aspects: It makes sure that all data sets have the same structure and that the annotation works fast. ANVIL allows that all of its annotations can be exported with time stamps and the resulting files can easily be imported into statistical packages.

2.4. Statistical Analysis

To test whether persons in a group display more auto manipulations than single persons and whether persons within a low and a high density of people display more auto manipulations than persons within a moderate (two to nine) density of people, the differences of occurred behavior patterns were explored with the *Pearson's Chi Square* test.

The duration of the behavior patterns depends on the persons' appearance in the surveillance video, which results in unequal coding patterns. Therefore relative durations were calculated by dividing the time a person shows one behavior pattern through the whole observation time of this person. Some behavior patterns occurred repeatedly, hence the data were aggregated by person and by behavior pattern, resulting in the absolute duration per behavior pattern and in one line per behavior pattern per subject.

To test whether a parametric or nonparametric test could be employed for further analysis, a *Kolmogorov-Smirnov* test was conducted. If the data were normally distributed a t-test was used. Otherwise a *Mann-Whitney U*-test was conducted using the one-tailed test for directional predictions and the two-tailed test for other comparisons.

I did the calculation with the whole data sample, then again with only the female sample, the male sample and the single persons sample, respectively. I used the single person sample to test the hypotheses of perceived safety regarding auto manipulations and density, because of the assumption that the perceived safety is different in group members and single persons.

I also compared the data from the station 'DOD' with the other stations, because of the fact that the 'DOD' station is related to the railway system of that city. With this comparison, I want to avoid that this fact leads to differences in the behavior. I will also compare the frequency of occurred auto manipulations and the relative duration of the occurred auto manipulations regarding the group size and the density only within the station 'DOD'.

The analysis was done in *PASW 18* for Mac.

III. Results

1. Descriptive Statistic

345 persons, 172 men and 173 women, were coded. As can be seen in Table 2, 64 persons were observed within a low density (less than two persons) of people, 184 persons within a moderate density (2 to 9) and 97 persons within a high density (more than 9). 234 persons walked alone through the ticket hall and 111 people walked in a group. Regarding the *size of the group* 234 persons were classified as single, 94 persons walked in groups of two and 8 persons walked in triads. Furthermore all members of one group of four and one group of five people were observed. This sample sizes are too small to calculate with the individual group sizes, therefore I only differentiate between single persons and persons walking in groups. All investigated persons were within the estimated age from adolescent to 60 years and without attachment. ‘Attachment’ includes a wheelchair, a baby carriage, a dog or a big and unhandy object that has to be pulled or pushed. The gender ratio is relatively balanced over the groups of interest, listed in Table 2.

Table 2: Cross table of the observed people, split into groups of interest.

		sex		density			group size		BER	DOD	station			
		male	female	> 2	2 – 9	< 9	single	group			MAR	MAS	PAR	POS
sum		172	173	64	184	97	234	111	45	162	58	16	18	46
sex	male			34	90	48	111	61	27	79	29	7	7	23
	female			30	94	49	123	50	18	83	29	9	11	23
density	< 2	34	30				53	11	23	10	17	1	4	9
	2 - 9	90	94				115	69	22	55	41	15	14	37
	> 9	48	49				66	31	0	97	0	0	0	0
group size	single	111	123	53	115	66			40	86	48	15	18	27
	group	61	50	11	69	31			5	76	10	1	0	19
station	BER	27	18	23	22	0	40	5						
	DOD	79	83	10	55	97	86	76						
	MAR	29	29	17	41	0	48	10						
	MAS	7	9	1	15	0	15	1						
	PAR	7	11	4	14	0	18	0						
	POS	23	23	9	37	0	27	20						

I received the data from videos of six underground stations in one city. The highest number of people was observed in the station called ‘DOD’, which is the main station of that city and which is located at the railway station. This is why the *density* is not equally distributed over all stations. All of the 97 persons which were observed within a density of more than nine

people were coded in the station ‘DOD’. On the other side people within a density of less than two were mostly observed in other stations.

The table 3 gives a short overview of the most frequently observed behavior pattern in the different tracks.

Table 3: A short overview of the most frequently observed behavior patterns in the different tracks (n=345).

category	track	frequency
<i>locomotion and posture</i>	to walk	99.7%
	to stand moving	35.1%
	to stand still	28.7%
	movement not straight forward	14.2%
<i>right limb</i>	arm swings free	46.7%
	manipulation of metro stations equipment	45.8%
	manipulation of moving objects	45.5%
	to carry an small object	52.8%
	to carry an big and handy object	35.4%
<i>left limb</i>	arm swings free	50.7%
	manipulation of moving objects	40.9%
	to carry an small object	32.5%
	to carry an big and handy object	41.7%
	manipulation of metro station equipment	13.3%
<i>right shoulder</i>	to carry a bag	36.2%
<i>left shoulder</i>	to carry a bag	21.7%
<i>gaze direction</i>	to look straight forward	85.2%
	to look at metro station equipment	60.9%
	to look at an object	34.2%
	to look at another person	28.4%
	to look around	25.8%
<i>face</i>	to laugh or talk	16.5%
	to talk on the phone	3.77%

2. Auto manipulations

At any time during the coding 64 people performed auto manipulations and 281 people did not. There were no sex differences in the occurrence of auto manipulations ($\chi^2=1.848$, $p=0.174$, $N=345$) and no differences in the occurrence of auto manipulations in the different stations ($\chi^2=1.495$, $p=0.914$, $N=345$). But there were differences in the duration of the auto manipulations regarding the different stations. People in the 'DOD' station performed auto manipulations for a shorter period of time than in other stations.(Mann-Whitney U-test: $Z=-2.081$, $p=0.037$, $N=64$; Mean rank: Other stations=37.34, 'DOD' station=27.66).

Auto manipulations & Groups

Group members did not perform less auto manipulations than single persons ($\chi^2=0.032$, $p=0.861$, $N=345$). To compare the relative duration of the occurred auto manipulations, the Mann-Whitney U-test was used, because the data did not show normal distribution. There were no differences in the duration of the occurred auto manipulations, displayed in Figure 8 ($Z=-0.217$, $p=0.828$, $N=64$).

If the data set was divided into male and female, there were also no differences in the occurrence of auto manipulations between group members and non group members (Table 4). The t-test (the data were normally distributed) showed that there were also no differences in the duration of the occurred auto manipulations between single persons and persons in groups if the data are divided into male and female (male: $t=-0.494$, $p=0.626$, $N=27$; female: $t=-0.127$, $p=0.900$, $N=37$).

Table 4: Results of the Chi-Square test of auto manipulations and group size (n=345)

Auto manipulations Chi-Square test		χ^2	p-Value
Single-group	Male	0.389	0.533
	Female	0.480	0.488

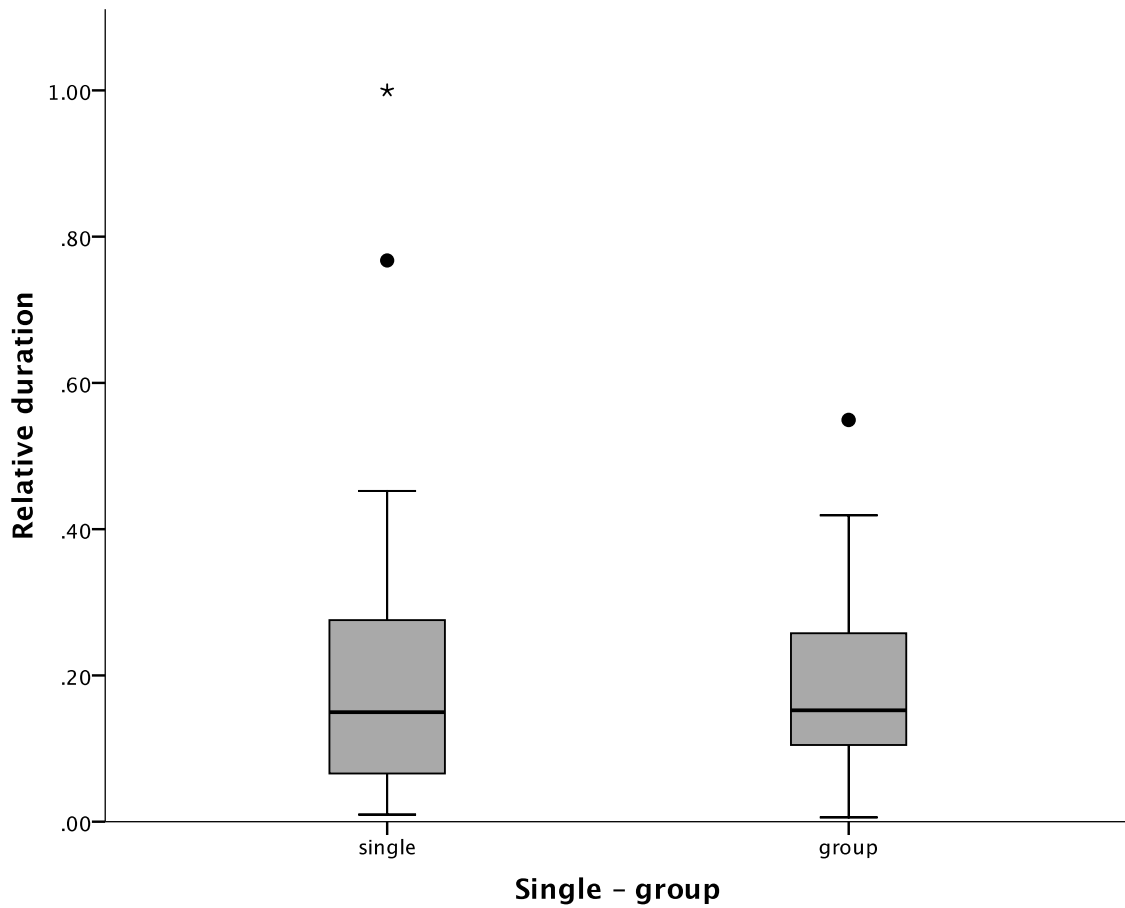


Figure 8: Results of the Mann-Whitney U-test of the relative durations of auto manipulations, comparison of single and group persons. Non group members performed auto manipulations as long as group members. Error bars: 95% CI.

Auto manipulations & Density

There were no differences in the occurrence of auto manipulations regarding the density of people in the ticket hall ($\chi^2=0.117$, $p=0.8943$, $N=345$). This means that at densities of less than two or more than nine people the focused person did not perform less auto manipulations than at densities between two and nine.

As the data were not normally distributed, a Mann-Whitney U-test was conducted to test differences between low and moderate as well as moderate and high density. There were no differences in the relative duration of the performed auto manipulations between low (less than two people) and moderate (two to nine people) density ($Z=-0.642$, $p=0.521$, $N=64$). Between high (more than nine) and moderate (two to nine) density were no differences in the relative duration of occurred auto manipulations ($Z=-1.834$, $p=0.067$, $N=64$). The tendency showed that people within a moderate density performed auto manipulations longer than people within a higher density (*Mean Rank*: Two to nine= 29.42; more than nine=21.42). The result was not significant.

If the data are divided into male and female, there were also no differences in the occurrence of auto manipulations between the densities (male: $\chi^2=1.690$, $p=0.430$, $N=172$; female: $\chi^2=2.182$, $p=0.336$, $N=173$).

To conduct the differences between low and moderate as well as high and moderate density a t-test was used, as this data were normally distributed. The results are shown in Table 5. Women performed the auto manipulations longer at moderate densities than at high densities (Figure 9).

Table 5: Results of the t-test of auto manipulations and density, divided in males and females.

Auto manipulations t-test		<i>t</i>	Mean			<i>p</i> -Value	<i>N</i>
			< 2	2 – 9	> 9		
<i>Low – moderate density</i>	<i>Male</i>	-0.137	0.1882	0.1939		0.626	22
	<i>Female</i>	-1.762	0.1586	0.2673		0.094	23
<i>Moderate – high density</i>	<i>Male</i>	0.233		0.1939	0.1680	0.823	20
	<i>Female</i>	-0.127		0.2673	0.1333	0.029*	32

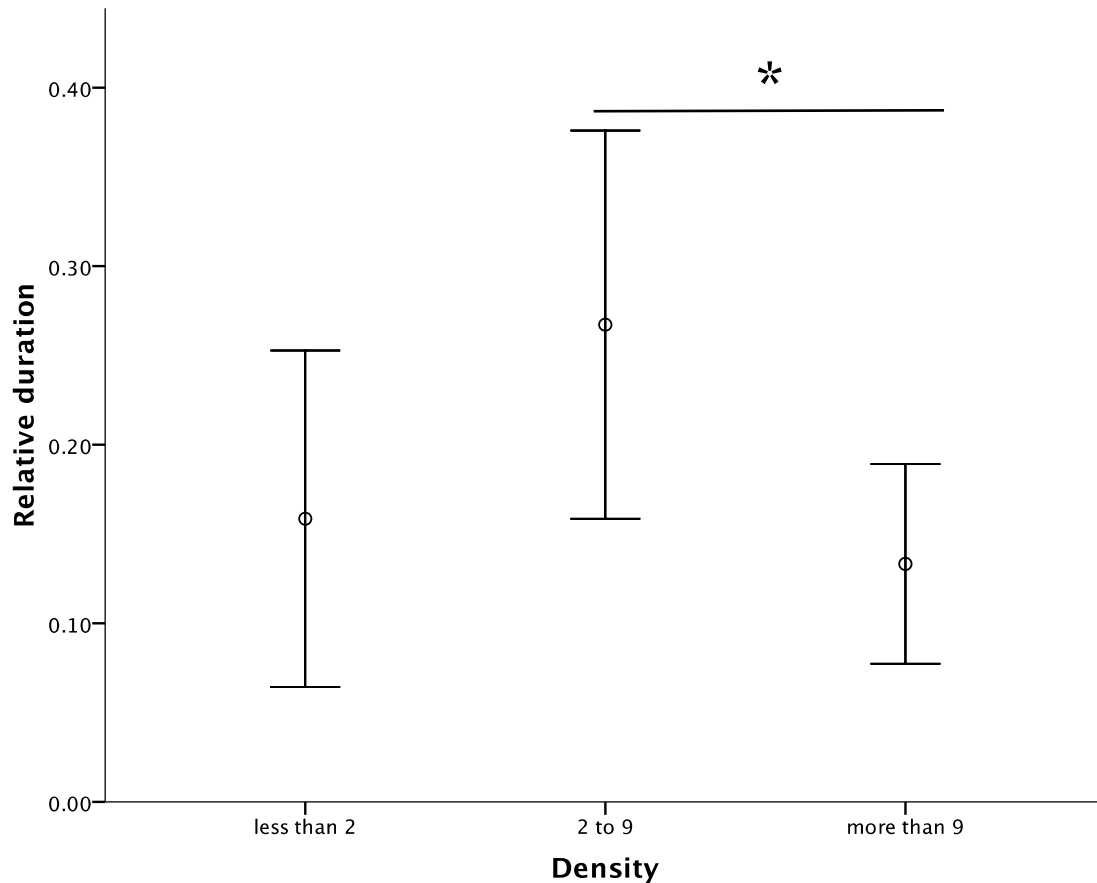


Figure 9: Results of the t-test of the relative durations of auto manipulations for women. Women within a moderate density performed longer auto manipulations than women within a low and a high density. The comparison of moderate and high density shows a significant result. Error bars: 95% CI.

For further analysis I used only the single persons of the sample. The Chi-Square test showed that there were no differences in the occurrence of auto manipulations regarding the density in the ticket hall ($\chi^2=0.401$, $p=0.818$, $N=234$).

The results of the t-test (data were normally distributed) are listed in Table 6. There were differences between the high and the moderate density. Single persons in a moderate density had longer durations of auto manipulations than single persons in a high density of people, displayed in Figure 10.

Table 6: Results of the t-test of auto manipulations and density, within the sample ‘single persons’.

Auto manipulations t-test	<i>t</i>	Mean			<i>p</i> -Value	<i>N</i>
		< 2	2 – 9	> 9		
<i>Low – moderate density</i>	-1.682	0.1638	0.2727		0.104	30
<i>Moderate – high density</i>	2.082		0.2727	0.1226	0.045*	34

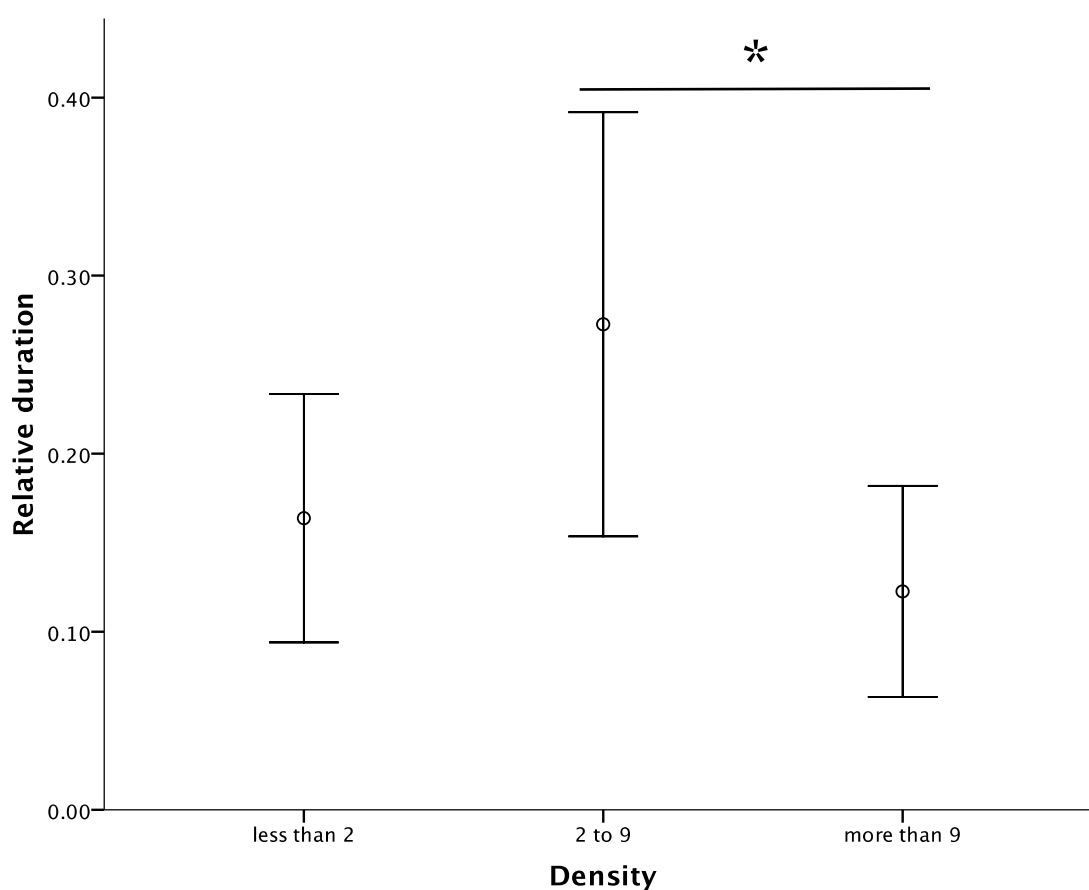


Figure 10: Results of the t-test of the relative durations of auto manipulations for single persons. People within a moderate density performed longer auto manipulations than people within a low or a high density. The comparison of moderate and high density shows a significant result. Error bars: 95% CI.

Auto manipulations within the station ‘DOD’

I wanted to take a specific look at the station ‘DOD’. Therefore I only used the coded people from the station ‘DOD’ for the Chi-Square test and the t-test (the data were normally distributed). There were no differences between single persons and group members as well as people within low, moderate and high density. The results are listed in Table 7.

Table 7: Results of the differences of the other behaviors, regarding the group size.

Auto manipulations – station ‘DOD’ Chi-Square test	χ^2	<i>p</i> -Value	<i>N</i>
<i>Single-group</i>	<0.001	0.996	173
<i>Density</i>	0.004	0.998	173

Auto manipulations – station ‘DOD’ t-test	<i>t</i>	<i>p</i> -Value	<i>N</i>
<i>Single-group</i>	-1.392	0.176	32
<i>Low – moderate density</i>	1.532	0.242	13
<i>Moderate – high density</i>	0.661	0.516	30

3. Other behaviors

I took an explorative look at the other behaviors, regarding the group size and the density.

Other behaviors & Group size

There were differences in the track *limbs*: Single persons did the behaviors arm swings free, arm posture and manipulation of moving objects longer than persons in a group. Differences in the track *gaze direction* showed that single persons looked longer at an object than persons in a group and single persons looked longer straight forward than group members. They looked longer at another person when they were in a group.

The results are listed in Table 8.

Table 8: Results of the differences of the other behaviors, regarding the group size.

Other behaviors U-test	U	Mean Rank		p -Value	N
		Single	Group		
<i>Arm posture</i>	-2.565	52.29	38.33	0.010*	91
<i>Manipulation of moving objects</i>	-3.004	159.51	127.08	0.002*	298
<i>To look at an object</i>	-2.308	64.61	49.15	0.021*	118
<i>To look straight forward</i>	-3.765	160.27	129.32	<0.001*	294

Other behaviors t-test	t	Mean		p -Value	N
		Single	Group		
<i>To look at another person</i>	-2.558	0.3529	0.5849	0.012*	98

Other behaviors & Density

Table 9 shows the results of the Mann-Whitney U-test (the data were not normally distributed). There were differences between the moderate (two to nine visible people) and the high (more than nine visible people) density. People within a moderate density performed following behaviors longer than people within a high density: Arm swing free, to look straight forward and walking. People within a low density performed the behavior looking around longer than people within a moderate density.

Table 9: Results of the differences of the other behaviors, regarding the density.

Other behaviors – Density		Z	Mean Rank			p-Value	N
U-test			< 2	2 – 9	> 9		
Arm swings free	Low – moderate	-1.138	118.19	130.32		0.225	254
	Moderate – high	-3.449		149.60	113.79	0.001*	277
To look straight forward	Low – moderate	-0.559	112.13	106.65		0.576	215
	Moderate – high	-1.976		127.18	108.32	0.048*	241
To look around	Low – moderate	-2.995	18.27	33.42		0.003*	58
	Moderate – high	-1.277		40.21	33.74	0.201	74
To walk	Low – moderate	-1.009	116.80	126.53		0.313	247
	Moderate – high	-3.063		150.81	121.05	0.002*	280

Other Behaviors – Density		t	Mean			p-Value	N
t-test			< 2	2 – 9	> 9		
To move not straight forward	Low – moderate	-1.323	0.2027	0.2865		0.206	37
	Moderate – high	2.062		0.2865	0.1865	0.046*	49

4. Further results

There are some further results which may be interesting for the general understanding of the behavior in the metro ticket hall. I found sex differences in the duration of following behaviors. Women performed arm postures for a longer time than men and women carried bags on their shoulders longer than men. The Mann-Whitney U-test was used because of not normally distributed data. The results are listed in Table 10.

Table 10: Results of sex differences of the other behaviors.

Other behaviors – Sex U-test	Z	Mean Rank		p-Value	N
		Male	Female		
<i>Limbs – arm swings free</i>	-3.242	34.63	52.78	0.001*	91
<i>Shoulder – bag</i>	-2.925	94.82	102.34	0.003*	200

It could also be observed that people carried an object with the left limb longer than with the right limb (Mann-Whitney U-test: $Z=-3.074$, $p=0.992$, $N=261$).

The comparison of the station ‘DOD’ with the other stations showed that there were no differences in the track *shoulder*. The track *locomotion and posture* showed differences in the category to walk. People at the other stations walked longer than people at the station ‘DOD’. There were also differences in the track *limbs*: The category arm posture showed that people at other stations performed them longer than people in the station ‘DOD’. The category primping also showed that people in other station performed them longer than people at the station ‘DOD’. Differences in the track *gaze direction* showed that people in the other stations looked for a longer period of time straight forward than people in the station ‘DOD’. Results are listed in Table 11.

Table 11: Results of the differences of the other behaviors, regarding the stations.

Other behaviors – Station U-test	U	Mean Rank		p -Value	N
		other Stations	Station 'DOD'		
<i>arm posture</i>	-2.192	51.74	39.86	0.028*	91
<i>primping</i>	-2.396	19.39	14.13	0.023*	33
<i>to look straight forward</i>	-4.006	165.89	126.14	<0.001*	294
<i>to walk</i>	-4.152	52.29	38.33	<0.001*	91

IV. Discussion

1. Auto manipulations

The results do not support the hypotheses that group members perform less auto manipulations than non group members and that people within a moderate density of people perform less auto manipulations than subjects within a low or high density of people. About every fourth person (23%) performed auto manipulations at any time during the observation.

It is proved that auto manipulators are associated with anxiety, guilt, discomfort, conflict, underlying negative affect, hostility, suspiciousness, stress, deception and closer proximity between participants through several studies (Ekman & Friesen, 1969; N. Freedman, 1972; Givens, 1987; Knapp, et al., 1974; LeCompte, 1981; Rosenfeld, 1966; Stokols, 1972).

The descriptive statistic shows the most often occurred behaviors which explain the 'usual' walk through the ticket hall. It has to be considered that people who walk from the entrance to the platform have to focus on the ticket and the barrier. It is necessary for everyone to hold a ticket in the hand and to put it into the ticket machine next to the barrier. The frequencies show that the subjects manipulate moving objects approximately as often with the right as with the left hand. The manipulation of the metro station equipment occur more often with the right hand than with the left hand. A possible explanation is that the ticket machines are on the right side of the barrier. Also 87-90 percent of all humans are right handed (Raymond, Pontier, Dufour, & Moller, 1996). This explains why people carry a big and handy object longer with the left limb than with the right limb, since the right hand is used to carry a small object (the ticket) and to manipulate the metro station equipment (the ticket machine). People who walk in the opposite direction, from the platform to the exit have to find a free barrier to walk through and look for the right exit.

These tasks – searching for the ticket, keeping it available to access the metro, and finding the right way out – can lead the focus away from the environment and other people.

During the observation I noticed some interference factors for the measurement of perceived safety in metro stations. One is the fact that I use six different stations for the coding. One of these stations is the main station of the city, connected to the railway system. All other stations connect the same underground line, but are located in different parts of that city. This means that every station has different circumstances which can lead to different

basic feelings. We do not know if, for example, one or more of these stations are in dangerous parts of the city or if there are any annoying construction areas which can affect the feelings. We only know that the six settings are comparably constructed.

The main station differs also regarding the security persons compared to the other stations. Every video recorded in the main station shows security persons at any time. Since this can influence the perceived safety, I searched for coding times when no security person was applicable. But I can not be sure that the observed people have not seen a member of the security guards before they entered the ticket hall, which can influence the perceived safety.

Another interference factor is the resolution of the videos. Sometimes it was very difficult to differ between the behaviors auto manipulations and primping. Only with the help of all three video perspectives and regarding the whole context was it possible to make decisions. It was not possible to differentiate between the categories of the track face. I saw group members' communication because of their gesticulations, but I could not say which one of them was talking at a given moment. The category gaze direction was also difficult to code because it was not possible to identify the eyes. Only because of the movement of the head and the upper body it was possible to code this behavior. The coding can be easier and more exact with a better resolution of the video and with the usage of more than five frames per second.

Generally there are many different factors leading to perceived safety and comfort, Thus a greater data sample is needed in order to make comparisons between special groups within the data sample. I explain these factors in the following chapters.

Auto manipulations & Groups

The results do not support the hypothesis that group members perform less auto manipulations than non group members. There are also no differences in the duration of the occurred auto manipulations, even if the data set is divided into males and females.

Apart from the interference factors listed above, there is one possible reason why the hypothesis is not supported: The social space boundaries, which act as a buffer zone (Lyman & Scott, 1967), loose their function if the group members walk. Knowles and colleagues (1967) found out that the extension of the boundary around a group increases with the size of the group, but Costa (2010) observed that large groups tend to split up in smaller groups while they are walking. This means that large groups give up their large boundary during walking.

This can be explained by the transferred focus, or by a greater overview of the setting during movement.

The barriers themselves can also influence the behavior of group members, because every person has to walk alone through this barrier, which force group members to split their social space boundaries. These social boundaries are important for their increased safety and comfort (Knowles, 1972).

I compared the group members with the non group members also in the 'DOD' station. Again, there are no differences, which leads to the assumption that the results of the whole data sample are not influenced by the different stations, although people in the other stations performed auto manipulations for a longer period of time than people in the 'DOD' station.

Auto manipulations & Density

The hypothesis that the focused person will perform more auto manipulations if the density of the people present in the ticket hall is less than two or more than nine persons than if the density of present people is between two and nine people can not be supported.

This can be explained by many different factors that lead to perceived safety and comfort. To measure the perceived safety regarding the density of the people in the metro ticket hall further information has to be reported. The affective consequences of a higher density depend on the sex of the subject, the sex of the invader and the spatial position (Fisher & Byrne, 1975). Furthermore, studies have shown that the tolerance of the presences of other people depends on the direction of the approach. Least of all is the approach from behind, greater from the side and greatest from the front (Sommer, 1969). Dubos (1965) explained that in the case of human population the number of people per unit area is not a good predictor for effective density. Other factors such as a clear reduction of tension and the ability to maintain stable hierarchies are important. In the perception of density the relationships between people and people, people and objects and objects and objects play a great role (Rapoport, 1975). Rapoport (1975, pp. 138-140) listed cues offered by every environment. These cues help people to judge the environments nature as well as the potential for offered action and to find appropriate behavior for it. The environment can be described as open vs. tight space, intricate vs. simple space, large building height to space vs. low height to space ratio, many signs vs. few signs, many lights vs. few lights, mostly man-made vs. mostly natural, high noise level vs. low noise level, many man-made smells vs. few man-made smells, fast tempos

and rhythms of activity vs. slow tempos and rhythms of activity, the absence of ‘defenses’ allowing the control of interaction vs. the presence of ‘defenses’ allowing the control of interaction, the absence of other adjacent places for use vs. the presence of other adjacent places for use. Not all of them are needed for environments to be perceived as one or the other, but certain physical and social cues are read and interpreted as indicating a dense environment. Even if environments have the same number of people per unit some of them may be perceived very differently. Areas with fewer people may be perceived as more dense, depending on some of the listed cues.

Another possible explanation why the hypothesis is not supported, can be a false classification of the density of people. The affective density model after Rapoport (1975) raises the question, which affective density is associated with isolation, ‘O.K.’ and crowding. How many or few people in the ticket hall are reducing the comfort and the perceived safety? I will try to find an answer with the help of the other behaviors in the following topic.

Furthermore, there are several interference factors, which can also influence the behavior in metro stations regarding the density of people. The station ‘DOD’ is connected to the railway system of that city, which means that the density in this station is always higher than in the other stations. This explains the unequal distribution of people in the different densities over the six stations. People within a high density were mainly coded in the ‘DOD’ station and people within a low density in the other stations. The data show differences between stations in the track limbs. People did the behaviors auto manipulations, priming and arm posture longer at other stations than in the ‘DOD’ station .

Another interference factor could be that the people who are walking from the barriers to the exits are coming from the metro, where the density is mostly higher than in the ticket hall. Depending on the higher density in the metro, the perception of the density in the ticket hall can be influenced, so that the density in the ticket is higher than perceived.

2. Other behaviors

Other behaviors & Groups

Non group members perform the behaviors arm swings free, arm posture and manipulation of moving objects longer than group members. Group members interact most of the time with each other. They gesticulate more with their arms, which can be a reason why non group members perform the arm swings free and arm postures behaviors longer than group members. The category arm posture is coded when the focused persons perform akimbo (one hand is lying on the hip and the elbow is turned outward), fold the arms or hands in the front or behind the upper body, put the hand in the pocket of a coat jacket or trousers or enclosed the stripes of the bag with one hand (when the bag was carried on the shoulder). Free swinging of the arms and arm postures are behaviors that people perform when they have nothing else to do with their arms. The manipulation of moving objects includes behaviors like reading and handling a mobile phone. These are behaviors that non group members perform more often than group members.

The result that single persons looked longer at an object or straight forward than group members and the result that group members looked at another person longer than single persons support the theory that people in groups focus on, and are interacting with their members.

Other behaviors & Density

What is a moderate density? The results show that persons within the 'less than two' density looked around longer than people within the 'more than nine' density. This can be attributed to the higher number of people in the high density which draws more attention to them. Few people in the field of vision do not lead the focus away from the main tasks.

Differences in the behaviors between 'more than nine' people and 'two to nine' people show that persons within a 'moderate' density of people performed the behaviors arm swings free, look straight forward and walk longer than persons within a high density of people. A density of more than nine people makes it difficult to focus on the own tasks, because the own

tasks are connected to other people. People are forced to adapt their walking speed, to walk around strangers, to wait in front of the barrier while people are walking through. Although this density can not be defined as crowding, it can relate to similar feelings. Not only the number of people per area relate to feelings of crowding, but also reduced open space, traffic, commercial development and noises relate to feelings of crowding (Carson, 1972).

The behavior arm swings free is a sign for relaxed feelings and is performed more often by people within 'moderate' density. The fact that people looked straight forward more often within the 'moderate' density seems intuitively clear, because there are not so many people in the field of vision. The differences in walking speed showed that either the persons in the 'moderate' density walked faster or the persons in the 'high' density waited longer in front of the barriers or performed other *locomotion and posture* behaviors longer.

In summary it can be said that the classifications less than two, two to nine and more than nine have to be revised. Further information would be necessary to imply on affective density.

Further results

The comparison of behaviors showed that women performed arm postures longer and carried their bags on their shoulders longer than men. The fact that women carry bags more often than men seems intuitively clear. The arm postures are standing in relation to the bags, since among others arm postures are coded if the focused persons encloses the stripes of a carried bag with one hand.

The comparison of behaviors in the 'DOD' station with the behaviors in the other stations shows differences in the tracks limbs, locomotion and posture and gaze direction. People in other stations perform primping and arm posture longer than in the 'DOD' station. People at other stations walk longer than people in the 'DOD' station. This difference can be explained by a faster walking speed in the 'DOD' station or by a longer waiting time to pass the barrier. The 'DOD' station is the most frequently used station, which means that sometimes people have to wait until other people have passed the barrier. This leads to a longer observation time and to a relative shorter walking time. It has to be considered, that the relative duration of a behavior always depends on the other behaviors in this category. In other words, if one behavior is above-average long, one or more other behaviors of this track have to be below-average long.

People in the 'DOD' station looked straight forward for a shorter time than people in the other stations. This can be explained by the connection of the 'DOD' station with the railway system of that city, which lead to a larger number of possible exits. The different exit makes it more difficult to find the right way. Another reason could be the different densities between the 'DOD' station and the other stations. A higher density means that more people are walking around, which draws more attention to them. If there are less people in the field of vision, it is easier to focus on the main tasks.

4. Prospect

The occurrence of auto manipulations regarding perceived safety and comfort is a very interesting field of research. 23 percent of all observed people performed auto manipulations, which is about every fourth person. This means that auto manipulations are an important part of the nonverbal behavior. The ticket hall was not the best setting to evaluate perceived safety of auto manipulations, depending on different conditions. A better place, where people don't have to focus on different tasks during the whole observation time, would be inside the train or on the platform. These settings provide longer waiting times and meanwhile the people don't have to focus on different tasks. During waiting times, group members are standing in their groups using their social space boundaries around them.

Further research in the ticket hall has to be done without interference factors. It would be better to focus only on one ticket hall which provides different densities. For this research it is important that no security person is present at any place in this station. It would help to improve the resolution of the videos and to use of more than five frames per second. A look at the exits, the stairways and the platform would be necessary in order to get an overview of the general density in this station.

It would also be interesting to examine the exact number of people which leads to a decrease of perceived manipulations and comfort. Therefore, more information has to be reported: The sex of the subject, the sex of the invader or invaders and the spatial position (Fisher & Byrne, 1975). Interesting questions are if the sex of the focused person or the sex of the other people play a role when only one person is present at the same time as the focused person, and how groups influence one single individual.

It would be great to have the exact frequency of people present at the time of coding, even if this is very difficult because many people leave earlier or enter later. In this research the inside of a train would be perfect, because between metro stations people have to stay in the train.

Furthermore it would be interesting to take a broader look at the different behavior tasks and categories independent from the groups or the density.

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VI. Appendix

behavior

catalogue

Summary: Tracks and Categories

sex

modifier: attachment

male
female
not visible

age

infantile to adolescent
adult
older than 60
not visible

size of the group

modifier: female, male, mixed

1
2
3
4
5
6
7
8
9
10
<10
not visible

setting

modifier: camera shot 1, 2, 3, 4, 5

hall
station platform
pass through area

prospect

observed
not observed
not visible

refuge

observed
not observed
not visible

locomotion and posture

to stand – still
to stand – moving
to stand – supported
to walk
movement – not straightforward
to run
interruption of the movement
bended posture
to sit
other
not visible

left limb

modifier: size of the object

arm swings free
arm posture

auto manipulation
primping
manipulation of moving objects
manipulation of metro station equipment
to carry
object on the floor
body contact
to gesticulate
other
not visible

shoulder left

modifier: size of the object

modifier: backpack

bag
to carry only a backpack
no object
not visible

right limb

modifier: size of the object

arm swings free
arm posture
auto manipulation
primping
manipulation of moving objects
manipulation of metro station equipment
to carry
object on the floor
body contact
to gesticulate
other
not visible

shoulder right

modifier: size of the object

bag
no object
not visible

face

to eat/to drink
to blow one's nose, to spit, to vomit
to laugh/to talk
to phone
not observed
not visible

gaze direction

look straight forward
other person
object
metro station equipment
read
look around
other
not visible

density

less than 2
2 to 9
10 and more

Definitions

sex male, female, not visible

possible criteria to distinguish the sex: body height, body shape, face, posture, gait, clothes, hairstyle

modifier attachment

wheelchair (persons, who sit in a wheelchair are not coded)

baby carriage (children, who sit in a wheelchair are not coded)

accompanied by a dog

a big and unhandy object that has to be pulled or pushed: carried with one hand/ arm in the directional movement of the carrying person in contact with the ground

a carried baby/child

age infantile to adolescent, adult, older than 60, not visible

possible criteria to distinguish the age: body proportions (the ratio of the head to limbs to trunk), face shape, body height, hair color, posture, gait

size of the group

modifier sex of the group members

female: group members are female

male: group members are male

mixed: group members are female and male

- 1: the focused person is alone
- 2: the focused person is in a group of two persons
- 3: the focused person is in a group of three persons
- 4: the focused person is in a group of four persons
- 5: the focused person is in a group of five person
- 6: the focused person is in a group of six persons
- 7: the focused person is in a group of seven persons
- 8: the focused person is in a group of eight person
- 9: the focused person is in a group of nine persons
- >9: the focused person is in a group more than ten persons

not visible

annotation: possible criteria for group size >1:

communication within the group members (minimum with one other person); the bodies of the group members are orientated to each other; spatial proximity or body contact within the group members, similar walking speed within the group members and/or coordinated walking behavior

if it is obvious that one person is in a group it can be coded, even if the spatial distance is bigger

setting

modifier camera shot

1/2/3/4/5 camera shot 1/2/3/4/5

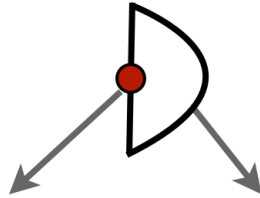
hall, station platform, pass through area

prospect

observed

unrestricted field of view within two meters radius of the semicircle (about 180°) in front of the focused person; objects which can be overlooked as well as persons generally are not a restriction of the view

in long corridors, for example at the station platform on person has prospect, if he/she has maximum view (that



is if the person is not standing with the back orientated to the wall)

focused person

$r = 2$ meters unrestricted area

not observed

not visible

refuge

observed

the focused person stands still (see also def. “to stand – still”), moving (see also def. “to stand – moving”) or supported (see also def. “to stand – supported”) – orientated with the back not more than one meter away from a wall or another backing surface

the refuge-position has to be hold on longer than two seconds

not observed

not visible

locomotion and posture

to stand – still

to stand

the legs and the upper body are stretched, the feet touch the ground and are not further apart from each other than the width of the hip

to straddle

the feet are spread wider than the width of the hip

one-legged

only one foot touches the ground and the other one does not

crossed-over

both feet touch the ground, the legs are crossed over

free leg

the whole body weight is transferred to one stretched leg, in contrast to the “one legged” stand the second foot touches the ground too

to stand – moving

to teeter

move or balance unsteadily; sway back and forth; the body weight alternates from the ball of the toes to the heel

to sway

the body weight alternates from one foot to the other while standing (see also def. “to stand”)

to flap

the upper body is rotated around the longitudinal axis in both directions

to ponce around

to behave in a ridiculous, ineffective, or posturing way; the person goes a maximum of three steps in one direction forward or backward, stands still (see def. to “stand – still”) or turns around (see also def. “to turn around”) and goes again maximum of three steps in another direction; the turn is mostly under a 180 degree

to step back

during standing (see also def. “to stand”) the right or the left foot optionally goes one step behind, the other foot follows; afterwards the persons stands still

to turn around during standing

to turn around without walking

to stand – supported**to lean on something or somebody**

one part of the body touches another person or an object to transfer its body weight vertically upon him/her/it

to rest on something – upper limb

one or both hands or arms are lying horizontally on another person or on an object; the weight is transferred upon him/her/it

to rest on something – lower limb

one foot is standing angled on a higher surface; the other foot is mostly stretched

to stand with crutches

the upper body is rested, with the assistance of the upper limb, on one or two crutches

to walk**to walk**

to move at a regular and fairly slow pace by lifting and setting down each foot in turn, never having both feet off the ground at once

to walk with crutches / walking aids

a limited method of movement with different aids (walking stick, crutches); normal step sequence, one foot after the other could not be possible

movement – not straightforward**to pace**

directionless method of walking (see also def. “to walk”); to walk more than three steps in one direction, then turn around anywhere (180°) and walk more than three steps in the contrary direction (it is unimportant how long the focused person goes in this direction, as long the other criteria are fulfilled)

to step to avoid

possible during standing (see also def. “to stand”) or walking (see also def. “to walk”); making one or more steps, optional with the right or left foot, to the right or left direction, the other foot follows; this happens to avoid a person or an object

to turn around/ to change the direction

possible during walking (see also def. “to walk”); to turn (see also def. “to turn around”) about 90° or 180° to the right or to the left and walk, beginning with the “free leg”, in the corresponding direction

to change the barrier

to walk (see also def. “to walk”) towards a barrier, stand still (see also def. “stand still”) in front of it, turn around (see also def. “turn around”) and walk towards another barrier

to walk or run not straight forward

to walk (see also def. “to walk”) or run (see also def. “to run”) without a goal, not the shortest way; could be in combination with avoiding something (see also def. “to step to avoid”)

to run

to move at a speed faster than a walk, never having both feet on the ground at the same time; but having both feet off the ground for a short moment

interruption of the movement

to stumble

to catch one's foot on something (an object or the own foot) and almost fall, because of momentary loss of one's balance; can happen during walking (see also def. “to walk”) or running (see also def. “to run”); the arms flail in the air to recover the normal body balance

to trip

to catch one's foot on something (an object or the own foot) and fall, because of momentary loss of one's balance; can happen during walking (see also def. “to walk”) or running (see also def. “to run”); the arms flail in the air to recover the normal body balance; but it is not possible to recover the normal body balance, so the arms are stretched in front of the body to protect the upper body and the head

to shove

to push someone with or without purpose roughly with the upper body, the upper limb or with any object; the pushed person can fall down or stumble

bended posture

to kneel

a position in which the body is supported by a knee or the knees; one or both Patella (kneecap) touch the ground; the upper body does not touch the ground

to bend over

to have the upper body bent forward (more than 45°); the shoulders and the head are bent, the feet touch the floor, the knees are not bent, the focused person does not move

to squat

the knees are maximum bent, the upper body is brought forward and down; the feet touching the floor and the heels close to or touching the buttocks

to sit

to be in a position in which one's weight is supported by one's buttocks rather than one's feet and one's back is upright; the buttocks touches a less or more horizontal plane

annotation: the act of sitting is included

other

the focused person shows another behavior as described above

not visible

the focused person can not be observed (restricted visibility because of the camera view or because of other people)

left or right limbs [anatomical left/right]

modifier size of the object

small: as big as the size of the fist of a hand to the palm of the hand

big and handy: bigger than the size of the fist/palm of the hand; can be carried with one arm (can incorporate straps or grasps)

big and unhandy: so big that the object has to be carried with both hands/arms; big and unhandy object which has to be pushed or pulled is classified as “attachment”

not present: no object is carrying

arm swings free

one arm swings free during standing (see also def. “to stand”), walking (see also def. “to walk”) or running (see also def. “to run”) next to the upper body – without an object

arm posture

akimbo

one hand lies on the hip and the elbow is turned outward

arms (or hands) are folded in front of the upper body

- both arms are bent; the forearms are crossed and cling to the upper body; the palms of the hands lie on the upper arm or between upper arm and upper body
- one arm is bent, the underarm clings to the upper body and the hand clasp the elbow of the other stretched arm
- the hands are crossed together in front of the body (the fingers are crossed, one hand overlaps the other hand, the other wrist or the other forearm)

to put the hand/hands in the pocket (coat, jacket, trousers, bag)

one arm is bent so that the hand is pushed into the pocket of the coat, the jacket or the trousers; one hand is lying on the bag

arms (or hands) are folded behind the upper body

the arms are retroverted; the fingers are crossed or one hand overlaps the other hand, the other wrist or the other forearm

to place the hand/arm on something

the hand/arm is placed on a carried object and lies there without noticeable movements

to rest the head on one limb

the head lies on the palm of the hand (for some seconds) or on the bent first

phalanges of the fingers from one hand; the elbow of the supporting limb touches the object or a part of the body below

annotation: “overrides” auto manipulation

auto manipulation

to touch the face

one hand touches the face

(compare with “to rest the head on the limb”)

to put one or more fingers in the mouth

one or more fingers are put into the mouth

to pick one’s nose

one finger is put in one nostril

to touch the head

one hand touches the head (without touching the face); no noticeable primping function (see also def. “primping”)

to hold one hand in front of the face

to cover the mouth and/or the nose with one hand

to touch the upper body

the palm of one hand is lying on the stomach, the shoulders, the breast bone (sternum) or the neck

to adjust the hair

to change the hairstyle with the help of one hand

priming**to hike up lower body clothing**

the trousers or the skirt are kept with one hand on the highest rim and are hiked up to open or close a coat

to zip a coat open or up; to undo or to do up the buttons of a coat; can happen with one hand or with the mouth

to handle with a scarf

to put a scarf on or off

to handle with a cap or hood

to put a cap or a hood on or off

to handle with glasses

to put the glasses on or off; to adjust the glasses

manipulation of moving objects

annotation: object permanence – the coding will not be interrupted if an object is shortly out of visibility, but situated in the same hand before and after

to inspect an object in the hand

to look at something closely; therefore an object is held by one hand (breast height); happens in combination with a supination of the forearm; the eyes look at the object and the head can be bended

to clench an object between the upper body and one arm

an object is placed between an abducted arm and the rib cage

to clench an object between the feet

the feet are moved together (adducted and maybe internal rotated) and hold an object in this position

to rummage around

one hand is leading into a concave object, where it is doing movements

to take an object out

one hand moves into a concave object B, the fingers of this hand overlap an object A; this object is taken out of the object B

to put an object in

one hand put an object A into a concave object B; afterwards there is no contact between the hand and the object A

to fold an object

an object is folded, so that its surface is smaller than before

to give over an object/to get an object

the focused person gives a small or bigger object to another person

to put an object from one hand to the other

object (full or almost enfolded from one hand) leads from one hand to the other hand

to look at a watch

the wrist is led in front of the body (breast height); the head is bent and the eyes look at an object which enfolds the wrist (watch)

to phone

one arm leads the hand, which is holding the object (mobile phone) towards the ear; when the object touches the ipsilateral ear, it is being held on this position while the lips and the mouth are in motion

to throw an object

to propel something with force through the air by a movement of the arm and hand

to catch an object

to intercept and hold (something that has been thrown) an object with one hand

to position an object on the body

- to bring an object with the help of one upper limb to a carrying position on the back or on the shoulders; the hands are free (see also def. “to carry an object”)
- to bring an object with the help of one upper limb from a carrying position without hands to a carrying position with one hand

to replace the bag

to bring the object (bag) with the help of one upper limb back into the regular position

manipulation of metro station equipment

annotation: intention movement counts for the behavior pattern

manipulation of the vending machine

the eyes are looking at the vending machine; the hand is led to the machine (with or without an object); the hand or the object is in touch with the machine; the hand is moved back (with or without an object)

manipulation of the barrier

an object (the ticket) is inserted into the ticket machine next to the barrier, thereby the barrier opens

to handle an elevator

to push the button of the elevator

to hold on the hand trail from the moving stairs

the hand is lying on the hand trail

to carry

annotation: object permanence – the coding will not be interrupted if an object is shortly out of visibility, but situated before and after in the same hand

“arm posture” and “auto manipulation” overrides “to carry” (but the size of the object is coded-modifier)

an object is carried along without a contact to the ground; with the help of the upper part of the body (one hand or both hands, on shoulder or both shoulders, on the side of the upper body or on the back)

object on the floor

to park an object

to put a carried object (see also def. “to carry an object”) on the floor; there is no longer a contact between the person and the object

to drop an object down

the contact between the person and the object is disconnected before the object touches the floor; the object falls down because of the gravitation

to lift an object up

the hand or the hands clasps an object, or part of an object, which has contact to the floor; the object is raised up to a higher position

body contact

to shake hands

the right, opened hand is held toward another person; this person clasps the hand and holds it/shakes it for a short moment (sometimes the left hand)

to hold hands

two or more people clasp each other by hand

to walk arm in arm

- two or more people walk beside each other; the arms next to the other people go around the others back; the palms of the hands are lying on the hip of the other person

- two or more persons are walking beside each other; the arms next to the other persons are bent; the arms are linked

to touch another person

to touch another person on his shoulder, back, head or arm

to give a hug

to hold someone tightly in one's arm; the arms enfold the body of another person; the upper bodies are in touch

to gesticulate

to support the verbal communication with a movement of a part of the body (hand, fingers and/or arm)

annotation: overrides object

other

the focused person shows another behavior as described above

not visible

the focused person can not be observed (restricted visibility because of the camera view or because of other people)

shoulder left (anatomical left)

modifier backpack

a bag, with shoulder straps allow it to be carried on someone's back

modifier size of an object

small: smaller than the size of the fist of one hand

big and handy: bigger than the size of the fist/palm of the hand; can be carried with one arm (can incorporate straps or grasps)

big and unhandy: so big that the object has to be carried with both hands/arms; big and unhandy objects which have to be pushed or pulled are classified as "attachment"

not present: no object is carried

to carry a bag

a bag is carried on the shoulder; if the bag is carried cross over the upper body, the side with the bag is coded (not the strap)

to carry only a backpack

a backpack (see also def. "backpack") is carried on the back; there is no additional object present

no object

not visible

the focused person can not be observed (restricted visibility because of the camera view or because of other people)

annotation:

- if the backpack is carried on one shoulder only: code it like a bag (to carry an object left or to carry an object right)
- if the backpack is carried on both shoulders on the back and there is an additional object present: code "modifier backpack" (object left)
- if the backpack is carried on both shoulders on the back and there is no addition object present: code "to carry only a backpack" (object left)

shoulder right (anatomical right)

modifier size of the object

small: smaller than the size of the fist of one hand

big and handy: bigger than the size of the fist/palm of the hand; can be carried with one arm (can incorporate straps or grasps)

big and unhandy: so big that the object has to be carried with both hands/arms; big and unhandy objects which have to be pushed or pulled are classified as “attachment”

not present: no object is carrying

to carry a bag

a bag is carried on the shoulder; if the bag is carried cross over the upper body, the side with the bag is coded (not the strap)

no object

not visible

the focused person can not be observed (restricted visibility because of the camera view or because of other people)

face

to eat or drink

to eat

some fingers are holding an object; this is led to the mouth; the mouth opens and the whole object or a part of the object is led into the mouth; the mouth closes (masticatory and swallow movement)

to drink

some fingers hold a bucket filled with some liquid; this is led to the mouth; the head is bent back; the mouth opens, then the liquid flows into the oral space; the mouth closes; then the head goes forward and the fingers lead the bucket away from the mouth

to blow one's nose, to spit, to vomit

to blow one's nose

to clear one's nose of mucus by blowing through it into a handkerchief

to spit

to eject saliva forcibly from one's mouth (without help of the limbs)

to vomit

to eject matter from the stomach through the mouth

to talk/to laugh

to talk

the lips and the tongue are in motion, the face is orientated towards another person

to laugh

to make spontaneous sounds and movements of the face and the body that are the instinctive expressions of lively amusement; the corners of the mouth are bent upward

annotation: “overrides” to eat or drink

If two persons are talking to each other and it is not visible which person is talking at the moment, then “talking” is coded as long as both persons are speaking to each other.

to phone

annotation: “overrides” eat and drink

not observed

not visible

the focused person can not be observed (restricted visibility because of the camera view or because of other people)

gaze direction

annotation: gaze direction is directed, when the object or the group member is located less than 2 meters away; the face of the focused person is orientated towards another person or an object; if the face gives not enough information, the posture of the body can help

to look straight forward

the focused person looks straight forward, the eyes are not focused on objects, metro station equipment or group members

other person

the focused person directs his view at another person, could be a group member

object

the focused person directs his view at an object, which is not a part of the metro station equipment (maximum distance of two meters)

metro station equipment

the focused person directs his view at an object, which is part of the metro station equipment (maximum distance of two meters)

read

an object (book, newspaper or electronic reading device; no mobile phone) is held with one or two hands and is placed in a field of vision; the eyes are looking at this object for a longer time (minimum 5 seconds), a short look up does not interrupt the coding

look around

the focused person looks around; this can happen together with movements of the head; the eyes are not focused on objects, metro station equipment or group members; the focused person changes the direction, one point of view is focused for a maximum of one second; the head turns minimum one time to the right and one time to the left

other

the focused person shows another behavior as described above

not visible

the focused person can not be observed (restricted visibility because of the camera view or because of other people)

density

the counted number of people which are visible at the same time as the focused person (the focused person does not count)

less than 2

2 to 9

10 and more

VII. Abstract

1. English

A person is always interacting with its environment and with the social units in this environment. Different conditions according to the setting refer to the level of comfort, which depends on the perceived safety. This is expressed through nonverbal behavior, especially 'auto manipulators'. Auto manipulators are associated with anxiety, discomfort and stress (Ekman, 1977; LeCompte, 1981; Rosenfeld, 1966). My diploma thesis is a part of an EU funded project, called *Vanaheim* (Video/Audio Networked surveillance system enhAncement through Human-cEntered adaptIve Montoring) which supplied me with video material collected in one European city. The main part of this study is the observation of behavior and the coding of people in the ticket hall of metro stations. The outcome was evaluated according to occurred auto manipulations depending on the density of people present and on the company of a friend. The hypothesis that group members perform less auto manipulations than non group members could not be supported. Further, I expected that the perceived safety would be increased if more than two or less than ten people were present in the ticket hall at the same time as the focused person. The results show no differences in the occurrence of auto manipulations between people within a low density (less than two), a moderate density (two to nine) and a high density (more than nine). The results are discussed in the context of the setting, interference factors and the data sample. An explorative look on the other behaviors in the ticket hall regarding the social units showed typical group behaviors, focussing on the group members. The explorative look regarding the density showed only one comprehensive difference between the low and moderate density and some differences between the moderate and high density. The results make it clear that the perceived density depends on more factors and that a better classification of different densities has to be deliberated.

2. German

Eine Person befindet sich immer immer in Interaktion mit ihrer Umgebung. Verschiedene Umstände dieser Umgebung führen zu einem angenehmen Gefühl, welches von der wahrgenommenen Sicherheit abhängig ist. Dieses kann durch nicht sprachliches Verhalten ausgedrückt werden, speziell durch die so genannten 'Automanipulationen'. Automaniationen werden mit Angst, Unbehagen und Stress assoziiert (Ekman, 1977; LeCompte, 1981; Rosenfeld, 1966). Meine Diplomarbeit ist Teil eines von der EU fundierten Projektes namens *Vanaheim* (Video/Audio Networked surveillance system enhancement through Human-centered adaptive Monitoring), welches mich mit Video Material aus U-Bahnstationen, aufgenommen in einer europäischen Stadt, unterstützt. Die Hauptaufgabe dieser Studie ist die Verhaltensbeobachtung und Kodierung von Personen, die sich in der Ticket Halle von U-Bahn Stationen aufhalten. Die aufgenommenen Daten werden nach dem Auftreten der Automaniationen, abhängig von der Personendichte in der Halle und der Begleitung eines Freundes, ausgewertet. Die Hypothese, dass Gruppenmitglieder mehr Automaniationen zeigen als nicht Gruppenmitglieder, wurde nicht unterstützt. Weiters erwartete ich, dass Individuen innerhalb einer Personendichte von weniger als drei und mehr als zehn Personen mehr Automaniationen zeigen als Individuen innerhalb einer Personendichte von drei bis zehn Personen. Die Daten zeigten jedoch keine Unterschiede bezüglich der Dichte. Die Ergebnisse wurden im Zusammenhang mit dem speziellen Umfeld, den Störfaktoren und dem generellen Datensatz diskutiert. Eine explorative Auswertung anderer nicht sprachlichen Verhaltensweisen zeigte typisches gruppenspezifisches Verhalten. Zwischen geringer (weniger als drei Personen) und moderater (zwischen drei und zehn Personen) Dichte gab es nur einen nachvollziehbaren Unterschied, zwischen moderater und hoher (mehr als zehn Personen) Dichte zeigten sich mehrere Unterschiede. Diese Ergebnisse zeigten jedoch, dass die Wahrnehmung verschiedener Dichte von mehreren Faktoren abhängig ist und dass eine andere Einteilung sinnvoller wäre.

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IX. Curriculum vitae

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Education

2007–2010 Studies in Anthropology focusing on Human Ethology,
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2007 Degree in General Biology,
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2005–2007 Basic courses in General Biology ,
University of Vienna

2004–2005 Basic courses in Science of Sport,
Karl Franzens University Graz

2004 A-levels Bundesbildungsanstalt für Kindergartenpädagogik,
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Additional qualifications

2006 National certified trainer in orienteering

2005 Ski and Snowsport instructor

List of Positions

03/2010–11/2010 University of Vienna
Research Assistant within the FP7 project *VANAHEIM*

10/2009–07/2010 University of Vienna
Course instructor at the University Sports Institute

07/2009-08/2009 LWB Gesellschaft für Umweltanalytik GmbH
Practical work in microbiology and analytical chemistry