Master Thesis

A FRESH LOOK AT TRAIN STATION CLEANLINESS

Effects of litter on the floor and graffiti on attention and cleanliness perception

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Voorwoord

Geachte lezer,
Voor u ligt mijn Master Thesis. Een project, een uitdaging, waar ik de afgelopen maanden vele uren en energie heb in gestoken. Mijn interesse in omgevingsgedrag is gewekt door het vak Service Environment, gegeven door Mirjam Galetzka. De manier waarop klanten, consumenten, eigenlijk de gehele bevolking tevreden wordt gesteld met behulp van aspecten in de omgeving, trok mijn interesse. Op een gegeven moment werd de nadruk gelegd op de NS, het ontwerpen van aantrekkelijke treinstations om het verblijf zo plezierig mogelijk te maken voor de reizigers, met daarbij de kanttekening dat hierbij ruimte is voor mogelijke afstudeerplekken. Dat liet ik mij geen twee keer zeggen, en zogezegd zo gedaan, kreeg ik de mogelijkheid om af te studeren bij de NS mijn afstudeeropdracht te volbrengen. Vanuit de NS bleek interesse te zijn naar een onderzoek met de mobile eye-tracking, op het gebied van reinheidsbeleving. Een nieuwe uitdaging voor mij, dit voor mij de eerste keer werd dat ik met deze techniek ging werken. Dit maakte mij gelijk enthousiast om dit project met beide handen aan te grijpen!

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Abstract

Purpose Due to limited processing capacity of the visual system, there is no way that people process all stimuli present at the same time. Research indicates that environmental (dis)order (e.g. cleanliness, graffiti) is a key predictor of service quality and evaluation of the environment in general. The aim of this study is to evaluate how people distribute their attention across different environmental disorders on train stations of Netherlands Railways. The following research question was formulated: *"What is the influence of several types of unclean environmental disorders (litter or graffiti) in a railway station on the passengers' attentional engagement and overall station evaluation?"*

Method The optimal level of different environmental disorders was determined by performing an online questionnaire (n=517). Results of the first study were used as input for the main study. The main study was performed on the train station of Enschede (n=165), a 2 (litter on the floor vs. no litter on the floor) x 2 (graffiti vs. no graffiti) x 2 (passengers current state: waiting vs. walking) between subject design was used to evaluate the hypotheses. Respondents wore a mobile eye-tracker and were instructed to either stand still in one place or walk a predetermined route through the train station. After spending half a minute on the train station, respondents filled out a short questionnaire about their experience of the environment. The mobile eye-tracker recorded all (unconscious) eye movements of the respondents. Which resulted in unbiased data about the attentional engagement (i.e. fixation counts and fixation durations) of the respondents.

Results It appeared, environmental disorders negatively influenced perceptions of cleanliness. Moreover, passengers looked more often and longer at graffiti compared to litter on the floor, graffiti negatively affected the evaluation of litter on the floor. In addition, it appeared that waiting passengers payed more attention to unclean environmental disorders compared to moving passengers.

Conclusion The presence of both, litter on the floor and graffiti, negatively influenced the perceived cleanliness and the overall station evaluation of passengers. Graffiti received more attentional engagement (i.e. fixation count and duration) compared to litter on the floor. Moreover, graffiti affected the cleanliness evaluation of litter negatively. The current state of the passengers (i.e. waiting or walking) affected attentional engagement to unclean environmental disorders, waiting passengers payed more attention to environmental disorders than walking passengers.

Limitations This study is limited in several ways. In practice, train passengers walk and stay during their journey. Future research in the field of attention could for example distinguish passengers with different travel motives (e.g. must or lust, run or fun) and frequencies.

Practical implications For NS (Nederlandse Spoorwegen – Netherlands Railways), the principal passenger railway operator in the Netherlands, a comfortable journey for the customers and the opportunity to spend time on a clean train station is one of the most important goals.

Keywords: Railway Station evaluation, Eye-tracking, Attentional engagement, Cleanliness, Litter, Graffiti.

1. Introduction

Throughout the day, individuals scan the environment by targeting objects like faces, words, images, and a variety of other objects. Service environments contain lots of information and objects. Due to limited processing capacity of the visual system and the given time one has, there is no way to process all stimuli simultaneously. Therefore, people select a subset from all the available information for further processing. Given the limited capacity to process information, it is interesting to evaluate which objects (e.g., information boards, trash, other people) receive most attention and influence our evaluation of the service environment. Service providers, and more specifically railway operators, spend millions of Euros to create safe and pleasant trains and train stations by the removing environmental disorders (Van Hagen, 2011). Environmental disorder significantly impacts rail authorities' expenditures and the operation of services (Thompson et al., 2012). In addition, environmental disorders negatively influence perceptions of cleanliness, service quality, safety, and aesthetics (Wakefield, & Blodgett, 1996; Hooper, Coughlan, & Mullen, 2013; Eboli, & Mazzulla, 2012), and influences the overall evaluation of a train station and other behaviors such as littering (Vilnai-Yavetz, & Gilboa, 2010; Hooper et al., 2013; Eboli, & Mazzulla, 2012). Since litter and graffiti are considered to affect the level of environmental disorders of a place (Keizer, Lindenberg, & Steg, 2008; Smith, & Cornish, 2006), great amounts of time and money are invested in the removal of unclean disorders such as litter on the floor and graffiti (Thompson et al., 2012). The goal of this study is to evaluate the impact of these environmental disorders (i.e. litter on the floor, graffiti) on the attentional engagement of passengers and their evaluation of the environment. The empirical part of the study will be performed on the central train station of Enschede.

1.1 NS

NS (Nederlandse Spoorwegen – Netherlands Railways) is the principal passenger railway operator in the Netherlands. With more than one million passengers each day, the NS aims to provide their customers a comfortable journey and the opportunity to spend time in clean train stations. However, passengers make a mess of the train compartments and railway stations by leaving garbage (e.g., used cups, cigarette butts, newspapers) on the floor (De Lange, Debets, Ruitenburg, & Holland, 2012). Both passengers and NS staff report that this is annoying and occurs regularly (De Lange et al., 2012).

Clean trains and railway stations are important for a pleasant journey (NedTrain, n.d.). Therefore, NS provides thorough cleaning of trains and railway stations, 24 hours a day and seven days a week. In the first half of 2017, investment in additional cleaning resulted in increased cleanliness perception of station (2016: 73%, 2017: 77%) (Nieuws.NS.nl, 2017). The main difference between general cleanling service and graffiti removal service is the labor intensity. The cleaning of one square meter takes only a few minutes, while the camouflage/removal of one square meter graffiti costs about an hour (NedTrain, n.d.).

1.2 Motivation for the study

Previous research has indicated that the attention one has for objects in the environment depends on visual saliency of objects and the objects' relevance to one's current goal (e.g. Nummenmaa, Hyönä, & Calvo, 2006, Desimone & Duncan, 1995). So, the distribution of attention among litter on the floor and graffiti depends on both the salience of environmental disorders and the goals passengers pursue. There are several studies on cleanliness of railway station environments. However, most studies concerning cleanliness on railway stations focus on the amount of litter and distraction of litter (e.g., De lange et al., 2012; Molenaar & Hu, 2013). Research on visual attention to and experiences of several types of environmental disorders (i.e. litter, or graffiti) lacks. In addition, most studies in this field were performed in a laboratory or virtual environment, using questionnaires to measure perceptions of cleanliness and the service environment in general (e.g. Eboli, & Mazzulla, 2012; Wardman, & Murphy, 2015). This study focusses on the attention of passengers towards several types of unclean environmental disorders and the passengers' overall cleanliness perception and station evaluation. The experiment was performed on a real railway station using a mobile eye tracking device combined with a questionnaire. The current approach is considered to be unique, compared to earlier studies in this field. The following research question arises for this study:

"What is the influence of several types of unclean environmental disorders (litter or graffiti) in a railway station on the passengers' attentional engagement and overall station evaluation?"

Passengers in a train station have different goals that are mostly related to their current state (i.e. waiting or walking). Waiting passengers have for example the goal to find distractors in the environment which distracts the waiting time. Walking passengers usually are on their way to a point of destination (i.e. the train or the kiosk) and do not want to be distracted from the right, shortest, and most efficient way to go. The goal of passengers is therefore a key determinant for allocating the awareness to current objects. The sub question contains the influence of these differences in current state, with the corresponding goal, on the process of environmental disorder attention.

"What is the influence of the passengers' current state (waiting or walking), on the process of visual environmental disorder attention?"

To answer these research questions, this study examines the influence of several types of environmental disorders on the passengers' attentional engagement and overall evaluation on the railway station Enschede Central, through an online questionnaire and an experimental field study. In the first study, the intensity and saliency of the unclean disorders (e.g. pieces of litter on the floor, placing of graffiti) was tested. In the second study, the attention to unclean disorders and station experience was measured by using a mobile eye-tracking device combined with a questionnaire. The mobile eye-tracking device records all the (unconscious) eye movements and locates the fixations (i.e. attention points) of the respondents. The questionnaire ensures to gain valid interpretations of scan patterns which are detected by the eye-tracking device (Mayr, Knipfer, & Wessel, 2009).

2. Theoretical Framework

The first step of this study is combining previous studies on attention (2.1), uncleanliness as environmental disorder of the railway station (2.2), passengers' actual states (2.3), and other covariates (2.4) to provide an overview of the theoretical concepts of this study so far.

2.1 Attention

Throughout the day, individuals scan the environment by targeting objects like faces, words, images, and a variety of other objects. Attention is defined as: "*The process by which we select a subset from all of the available information for further processing"* (Tobii AB, 2017). When it comes to attention, a distinction can be made between overt and covert attention (Nummenmaa et al., 2006):

Overt attention:	Measurable attention of the eyes. The eye movements as behavioral manifestation of allocation of attention.
Covert attention:	The attention of the mind without deploying the eyes.

Attention to certain objects is the result of an interplay between covert and overt attention. Covert attention detects objects in the peripheral field which is followed by an eye movement to that area. The eye movement to a specific area is the so called overt attention, i.e. the task of seeing the things that are detected in the peripheral field by the covert attention. The overt attention is a combination of very rapid eye movements (i.e. saccades) and relative gaze stability (i.e. fixations) (Henderson, 2003). Fixations can be defined as very short 'stops' of eye movements, indicating that attention resided somehow (Eghbal-Azar & Widlok, 2013). Saccades, on the other hand, are rapid eye movements between fixations, performed spontaneously, duration varies. (Eghbal-Azar & Widlok, 2013). During saccades, it is hard to perceive anything with the eyes, someone is basically 'blind'. The fixations are done in an apparently zigzag fashion that seem to be very unsystematically (Land & Tatler, 2009). Since this study is about the extent to which different environmental disorders are being detected (i.e. fixated upon) and its impact on station evaluation, the overt attention will be measured, using an eye-tracking device. Eye-tracking technology records all the movements (i.e. overt visual attention) and is able to make a distinction between fixations and saccades[1] (Figure 1).

Figure 1*:* Scan pattern of one viewer during visual search.
The circles represent fixations (scaled in size to their durations in milliseconds) and the lines represent saccades (Henderson, 2003).

[1] More eye tracking technology in the methodology section (4.3.1.)

2.1.1 Levels of attention

All objects on a railway station (i.e. timetables, lockers, in/out check gates), have visual saliency. This visual saliency represents the relationship between that object and other objects in the scene (Michael & Gálvez-García, 2011). Visual saliency is a result from a comparison of elementary visual features and serves to ordering, an aspect for attention (Michael & Gálvez-García, 2011). The major function of this attention (i.e. attentional orienting) is to ignore irrelevant and select relevant stimuli in the environment for further scrutiny (Nummenmaa et al., 2006). The visual attention that is given to an object when it is perceived as relevant, is called attentional engagement. So, there are two levels of attention that are relevant for this study (Nummenmaa et al., 2006):

Attentional orienting:	The probability that one object received the first fixation after the eyes left a central fixation point, and the latency of making a fixation to one of the two target objects (litter vs. graffiti). In other words, the fast reaction time to an object.
Attentional engagement:	The summed duration of fixations made on the initially preferred object before fixating away from it, and the number of fixations made during the visual encounter with an object. In other words, the slower reaction time to an object.

The way we perceive things visually differs, depending on the context and an object's relevance to our current goals (Eghbal-Azar & Widlok, 2013; Desimone & Duncan, 1995; Bays, Singh-Curry, Gorgorapits, Driver, & Husain, 2010). Goal-directed factors are demonstrated by our ability to detect and orient to a target object based on a pre-specified feature (such as location) distinguishing it from distractors (Bays et al., 2010). The number of objects that can be intensively observed on the attentional engagement level (i.e. the competition among multiple objects), depends on the goal one has while analyzing the environment. At this point, the visual saliency and the current goals are coming together. The competition between multiple objects for visual attention is visualized in Figure 2 (Kastner, & Ungerleider, 2000; Buschman, & Miller, 2007). The vertical line in Figure 2A, is detected effortlessly and quickly among the multiple distracter lines, because of its salience in the display. The vertical line here has the advantage of the competition, thanks to the salience. The attention to the vertical line takes very little time. In Figure 2B, the competition for the vertical line is much harder and is not resolved by salience. Active search through the display is needed to identify the vertical line. It is therefore logical that more time and longer pulled attention is needed in this situation to distinguish the vertical line.

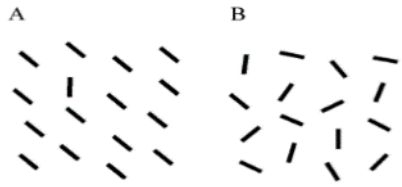


Figure 2: Cluttered visual scenes.

2.1.2 Bottom-up and Top down theory

The example in Figure 2A is an example of bottom-up, stimulus-driven cognitive processing (Kastner & Ungerleider, 2000), and illustrates that some objects in the space stand out. Bottom-up features of attention refer to the visibility of an object, and is a fast and automatic process. The visual properties give rise to a representation that explicitly marks regions that are different from their surround on one or more image dimensions, such as color, intensity, contrast, and edge orientation (Henderson, 2003). For example, in a field of yellow tulips, according to the bottom-up principle the fixation while watching this field will go to the single red rose. The rose is after all at the level of visual properties (i.e. color, shape and size) in contrast with the rest of the scene.

The example in Figure 2B is known as the top-down cognitive process (Buschman, & Miller, 2007), and derived from knowledge about the current task, there is more time needed to see the specific object. Top-down factors are cognitive in nature, and individuating. Top-down factors are the statement of the task, the environment, prior knowledge or experience, and socioeconomic characteristics (Tobii AB, 2017). Top-down factors consists the cognitive systems, including short-/long term memory, information about the scene, and the goals and plans of the viewer, that control the effectuation of eye movements (Henderson, 2003). Finding lost keys in a full purse, is a form of top-town attention. Despite that brightly colored objects are present in the bag, that are also bigger than the key, the key will be detected first, because the goal was to find the key. Moreover, if the goal that one has shortened the time to explore the area, the goal reduces the likelihood that objects that are not based on salience, such as the vertical line in figure 2B, grabs someone's' attention.

The next part will explain how the cluttered visual scenes and the corresponding effort for attention. Moreover, we will describe the bottom-up and top-down approaches in relation to railway stations and environmental disorders, as well as with the current state of the passengers.

2.2 Uncleanliness as environmental disorder of railway stations

Cleanliness is general seen as one of the most valuable aspects of the experiences of passengers on railway stations (e.g., Wakefield, & Blodgett, 1996; Celik, Aydin, & Gumus, 2014; Eboli, & Mazzulla, 2015; Goel, Ghosh, Kumar Ojha, & Kumar, 2016). However, most studies of cleanliness on railway stations were concentrated on the amount of litter and the perceived cleanliness in general. Research on the combined effect of several types of uncleanliness is scarce. Cleanliness can be subdivided into actual and perceived cleanliness:

Actual cleanliness: Refers to human activities in public space that create litter such as cigarette butts, tin cans and newspapers (Becherucci & Seco Pon, 2014) [cited by Vos, 2015].

Perceived cleanliness: Refers to the perception of litter, as a combination of the actual amount of litter with secondary factors, such as lighting and weather conditions (Molenaar & Hu, 2013).

Uncleanliness can be defined as disorder of the environment (Keizer et al., 2008; Smith, & Cornish, 2006). Together with the determination about cleanliness as one of the most valuable aspects of environment experiences, lead this to the assumption that uncleanliness could be seen as dissatisfier. Dissatisfiers are conditions of a product or service performance that are necessary but not sufficient (Johnston, 1995). Which means that dissatisfiers negatively influence the customer satisfaction when insufficient or not present. Generally speaking, dissatisfiers will not positively influence overall customer satisfaction with a service or product. The counterparts are satisfiers, which are performance of a product or service that are unusual and elicited strong feelings of satisfaction (Johnston, 1995). Absence or insufficient satisfiers did not necessarily cause negative feelings. Since uncleanliness is an environmental disorder which is considered to be one of the dissatisfiers present on a railway station. The following hypothesis was formulated for the relationship between cleanliness and the overall station experience.

> *H1*: Passengers evaluate the railway station more clean and pleasurable in the clean situation, than in the unclean situation.

The perceived cleanliness of an environment may vary per passenger and is influenced by ambient factors in the service environment. For example, high levels of illuminance ensure that passengers experience the train station as cleaner (Molenaar & Hu, 2013; Vos, 2015). So, lighting has an influence on the cleanliness perception as well as scent. De Lange et al., (2012) showed that littering behavior reduced in train compartments when cleaner scent was dispersed. Gostelie (2017), found an interaction effect between music and cleanliness. When train compartments were unclean, fast tempo enhanced passengers' appraisal of time.

As confirmed by the study of Wyles, Pahl, Thomas, and Thompson (2016), the trash itself could also lead to different perceptions of cleanliness. They showed in their study a different response among

the respondents in four different waste situations for coastlines: clean, natural litter, litter of fishermen and public litter. Littered coastal environments were seen to have a lower restorative quality, were less liked, and resulted in lower mood than did the natural scenes (also with the natural litter) (Wyles et al., 2016). Moreover, public-litter was seen to be especially bad and was associated with physical risks (Whyles et al., 2016). Little is known about the influence and combination of several types of uncleanliness on a railway station, such as: litter on the floor (i.e. cigarette butts, tin cans, or newspapers) and graffiti.

2.2.1 Saliency

Both litter on the floor and graffiti can be considered as environmental disorders (Keizer et al., 2008; Smith, & Cornish, 2006). However, there are obvious differences between both types as well. The first difference is in the visual properties of both types of environmental disorders. Graffiti is most cases more colorful and of a larger size than litter on the floor. Graffiti can occur in many different forms, such as large, colored cartoons or small single words in one color (Thompson et al., 2012). The major form of littering consists primarily of cigarette disposals, with 84% of cigarettes smoked being littered (Wilson, Oliver, & Thomson, 2014). According to the bottom-up principle (i.e., representation of objects in contrast to their surround on one or more image dimensions), the different visual properties of the environmental disorders may lead to differences in saliency (Shan, Lin & Chen, n.d.) and therefore attentional engagement (Kastner & Ungerleider, 2000).

2.2.2 Associations

The second difference between the environmental disorders concerns the association. The associations are mainly formed by the underlying reasons why someone is littering or is spraying graffiti. Graffiti has been defined as painting or drawing words or pictures (so-called individual or crew tags[2]) onto varied surfaces, with the main aim to be recognized (Thompson et al., 2012). Graffiti is a form of symbolic communication with different social individual meanings (Snyder, 2011), and is frequently based on socio-political opinions (Thompson et al., 2012). Littering is considered as a violation of social norms (Keizer et al., 2008). In addition, the presence of litter is associated with laziness, poverty, a lower status and immortality (Vilnai-Yavetz, & Gilboa, 2010; Harris & Sachau, 2005). In general, people have more 'extreme' and safety related associations with graffiti, such as crime, vandalism, and gang violence (Smith, & Cornish, 2006; Halsey, & Young, 2002). Depending on the location and type of graffiti, graffiti can also be considered as a form of art (Thompson et al., 2012). Associations about both types of environmental disorders consist also of the extent to which the disorders are assessed as dirty. It can be assumed that one would prefer to touch a bench with graffiti, then to touch a bench with cigarette butts. These differences in association ensures that there is different knowledge about both these types of disorders, which in turn leads to differences in motivation, and therefore in attentional engagement. This is in line with the top-down principle, which shows that difference in knowledge leads to a different

[2] A graffiti tag is an individual identifier like an 'artistic' signature. Taggers can work in a 'crew' of between two and 12 people and are often interested in sustaining a form of collective identify, whereby the crew has a name (Thompson, 2012).

degree of saliency (Shan et al., n.d.) and therefore a difference in attentional engagement (Buschman, & Miller, 2007).

It remains however unclear which difference in associations are considered to be most important. It is therefore also unclear which environmental disorder will receive most attentional engagement and have the most effect on cleanliness perceptions and overall station evaluation. Graffiti is expected to win the competition according to the bottom-up theory. However, this study will investigate the influence of saliency, and the associations of litter on the floor and graffiti on attentional engagement according both, bottom-up and top-down theory, leading to the following question:

> *Q1*: Which unclean environmental (i.e. litter on the floor or graffiti) disorder will receive the most attentional engagement?

The number of objects that can be intensively observed on the attentional engagement level is limited, and there will be one of the disorder that wins the competition and received the most and longest fixations (i.e. attentional engagement). Considering the bottom-up and top-down theory, we expect that graffiti will receive the most attention. Graffiti has a more salient visual expression and has heavier underlying associations. However, litter could win the competition regarding the dirtiness level and the cleanliness perception. Instead of receiving the most attention, there is also a possibility that the environmental disorders reinforce each other in the field of attentional engagement and cleanliness/station evaluation. In other words, if one disorder is noticed, the other disorder will be evaluated more negatively or positively then when this disorder was present at the railway station alone. As mentioned before, it cannot be said for sure which environmental disorder will receive most attentional engagement and which environmental disorder influence the perception of the other disorder. But because both environmental disorders possess properties that could win the competition, it can be suggested that an interaction effect occurs when both these two disorders types are present at the railway station. The following hypothesis can be formulated when combining the bottom-up and top-down principles, and the properties of both environmental disorders:

> *H2:* There is an interaction effect between litter on the floor and graffiti, that influence the attentional engagement. Whereby the presence of litter on the floor reinforces graffiti attention, and vice versa.

The environmental disorder attention of the passengers might also be influenced by the passengers' current state (walking vs. waiting) (i.e. differences in goals that passengers have in mind). The next section explains how differences in current state and therewith in goals, will influence the attention engagement.

2.3 Passengers' current state (waiting vs. walking)

Passengers in a train station have different goals that are mostly related to their current state (i.e. waiting or walking), which influences the passengers' evaluation of the environment. Several studies concerning the different experiences of waiting behavior on a railway station (Van Hagen, Galetzka, & Pruyn, 2014; Van Hagen, 2011), and walking behavior on a railway station (Davidisch, Geiss, Mayer, Pfaffinger, and Royer, 2013) are done already. Both, waiting and walking passengers are present at a railway station. However, both types of passengers experience the station in diverse ways, because they are pursuing different goals (Van Hagen et al., 2014) and have therefore differences in attention engagement. What exactly the difference is between the current state of the passengers and their corresponding goal on the attentional engagement of these passengers, is investigated in this study.

2.3.1 Distinction between waiting and walking passengers

Waiting passengers have, for example the goal to find distractors in the environment which distracts the waiting time. Walking passengers usually are on their way to a point of destination (i.e. the train or the kiosk) and do not want to be distracted from the right, shortest and most efficient way to go. The goal of the passengers that is related to the current state of the passengers, is therefore a key determinant for allocating the awareness to current objects. Below, the concepts of waiting and moving passengers were defined:

Waiting passengers	Standing still, with the goal to find a distraction to make their wait more pleasant (Pruyn & Smidts, 1998; Van Hagen et al., 2014). With the needs for comfort and experience (i.e. a clean station).
Walking passengers	Looking for the right, shortest and most efficient way to go (van Hagen et al., 2014; Davidisch et al., 2014). With the needs for speed and ease.

Waiting passengers

This distinction between waiting and walking passengers shows the differences in goals and time that passengers have for creating attention to the disorders. Waiting passengers have more time to spend for looking around in the area. In line with the top-down principle, objects like the vertical line in Figure 2B and the lost key in the example in paragraph 2.1.2., could grab the attention of these passengers. Thus, objects that are not based on visual saliency and therefore stand out of the area of themselves, are objects that can be observed by the waiting passenger. This suggested that waiting passengers have more attention to litter on the floor. However, they are also looking for distraction. Looking to (colorful) paintings could also be a waiting time distraction. Therefore, for the waiting passengers, it is not clear yet which environmental disorder will receive most attentional engagement.

Walking passengers

Walking passengers have less time to look around and have a goal to arrive as quickly and easily at the point of destination. The quickest and easiest way to go, is referred to as the walkability of the walking route. The cleanliness of the walking route is one of the two best characteristics to evaluate the walkability (together with safety) (Toker, 2015; Rahimiashtiani and Ujang, 2013). Unclean pedestrian environments are evaluated as less walkable, compared to clean pedestrian environments (Toker, 2015). Litter on the floor can be seen as an obstacle that is avoided while walking and therefore influences the speed and ease of walking route. This is supported by Pandey (2016), who stated that: "any kind of obstruction present of the pathway makes people to avoid walking on that area". Garbage is appointed in this study as an obstruction of the pathway. Together, leading to the following hypothesis:

> *H3:* Walking passengers have more attention engagement to the litter on the floor, than to graffiti.

As mentioned in 2.1, the way we perceive things visually differs depending on the context and the goal someone has. For instance, reading the messages took more effort when walking than when seating in an armchair. This is, because there is less time and mental capacity available when being involved in bodily action. Moreover, seeing things while being involved in bodily action involves also more parts of the brain than in position of rest and it is connected especially to the executive of our working memory (Baddely (2007) [cited by Eghbal-Azar, & Widlok, 2013]). So, more mental capacity is needed to perceive the environment around when passengers are walking. In line with the top-down principle, the limited time available for moving passengers, results in little to none attentional engagement with objects that are not related to their goal (i.e. quickly and easily to their point of destination). Waiting passengers on the other hand are searching for distractors in the environment. As a result, it is suspected that:

> *H4:* Waiting passengers have more attention engagement (compared to walking passengers) to both types of environmental disorders.

2.4 Covariates

Prior studies have indicated that there are secondary factors that might influence the perception of cleanliness. Beside the ambient elements mentioned in 2.2, the following covariates were identified to might have an influence on attentional engagement and cleanliness perceptions and will be monitored during the experiment: Density (2.4.1), time of the day (2.4.2.), railway station familiarity (2.4.3), and weather (2.4.4).

2.4.1 Density

The NS services a million daily passengers (Pel, Bel, & Pieters, 2014). It is therefore essential to take density into account when researching passengers' experience of train stations. The level of density varies over the day, it might be extremely busy during peak hours and extremely quiet during off-peak hours. Stokols (1972) defined perceptions of crowding as a psychological frame of mind in which the demand for space is greater than the available space. Previous research indicates that crowding negatively influences satisfaction (e.g., Eroglu & Machleit, 1990; Van Hagen, 2011) and could possibly influence the perceived cleanliness and general perception of the service environment. Therefore, the crowding levels will be monitored during the experiment.

2.4.2 Time of the day

Beside the density, the mood of people is related to the time of the day (Diaz-Morales, Escribano, & Jankowski, 2015) as well. That is, the time of the day influences the overall experience of emotions associated with positive (negative) activation, including excitement (calm), cheerfulness (dreary), and alertness (thoughtless) (Diaz-Morales et al., 2015). These mood fluxes could possibly affect the attention that is being in the railway station. Hence, the time of the day will be included in the experiment.

2.4.3 Railway station familiarity

Environmental familiarity means that one had increased knowledge concerning objects and/or locations in the environment, relative to unfamiliar environments (Prestopnik, & Roskos, 2000), with certain expectations of how the environment should look (Peelen & Kastner, 2014). The environmental disorders in this experiment could break through the regularity. Therefore, familiarity with the environment facilitates the attention to distractors. So, being familiar with the train station affects the attention that is directed to the manipulated disorders and the overall evaluation of the train station, and will therefore be monitored during the experiment.

2.4.4 Weather

Nothing changes so much as the weather. The weather could have considerable influence on the mood of people and the attention paid to the area. Especially when someone needs to wait or walk in the open air. Since this experiment involves a field study on an actual station, the weather could be of major influence. Therefore, the weather is the last covariate that will be monitored during the experiment.

2. 5 Theoretical model

Based on the foundations about the types of environmental disorders and the current state of passengers as explained in the foregoing, the following research design is developed for the current study (Figure 3).

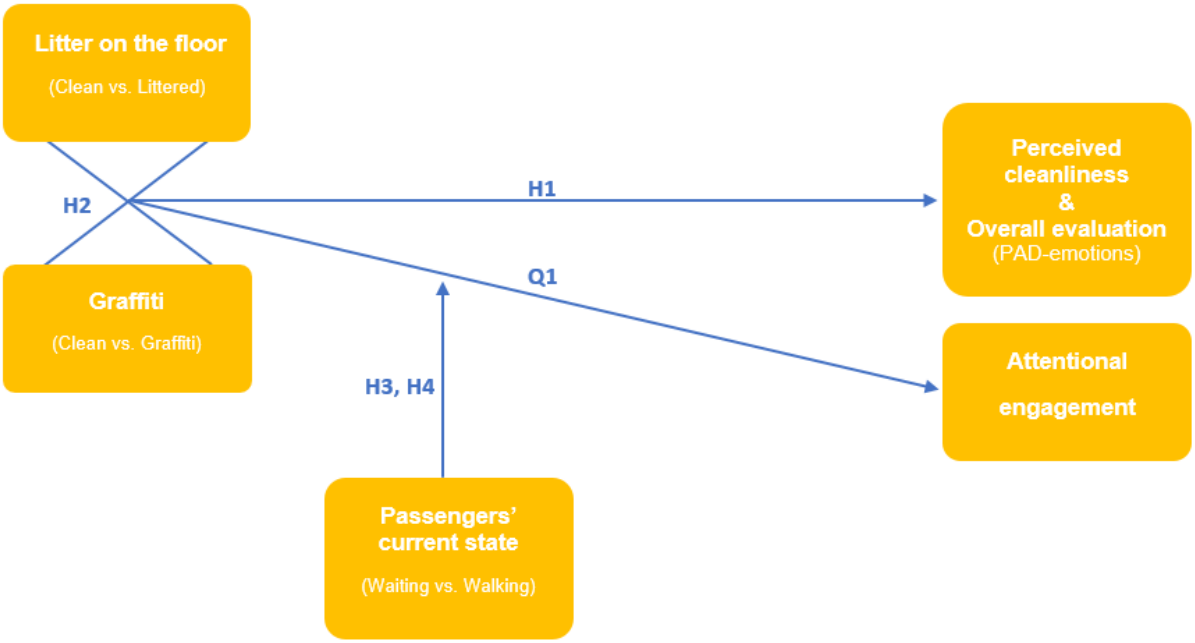


Figure 3: Theoretical model for the current study

The following chapter elaborates on the first part of this study (Study 1) to evaluate the amount, associations and salience of the environmental disorders (Chapter 3), followed by the measurement method for the main study (Study 2) (Chapter 4). Then the results derived from the experiment will be evaluated (Chapter 5). Finally, the discussion and conclusion (Chapter 6) come back to the theoretical model in order to (dis)confirm the formulated hypothesis for this study.

3. Study 1

A first study was performed, to evaluate saliency, and associations of the environmental disorders (i.e. litter and graffiti), and the total amount of environmental disorders that is needed to evaluate the railway station to be unclean. Actual cleanliness was manipulated using the New York City street cleanliness scorecard (van Ryzin, Immerwhar, & Altman, 2008). This scorecard made use of seven levels of cleanliness to evaluate the amount of trash in an environment.

3.1 Stimuli

The study stimuli consisted of eight photographs (one of each condition: clean, low degree of litter or graffiti, medium degree of litter or graffiti, high degree of litter or graffiti and one with litter and graffiti in the medium gradation) taken of the station Enschede Kennispark under dry weather conditions (Appendix A). Following Bateson and Hui (1992) and Nasar and Hong (1999), the psychological effects of photos can be assumed to be similar to effects in the field. Litter on the floor items found on-site that are commonly found at railway station (i.e. cigarette butts, tin cans and newspapers) were deposited at the station. The graffiti was edited in the photograph using computer software, so that the background was identical to the respective clean state. The graffiti is taken from the graffiti that was found in a tunnel at station Enschede Kennispark.

3.2 Questionnaire

The questionnaire for study 1 consist of five constructs, and is included in Appendix B. Items were based on prior studies of Vos (2015), Vilnai-Yavetz, and Gilboa, (2010), and Halsey and Young (2002). The several items measure, attractiveness, safety perception, cleanliness, association, and saliency. The items consisted of a 5-point Likert scale ranging from 1 (highly disagree) to 5 (highly agree).

Attractiveness

Attractiveness was measured with two items (α=.68). The two statements were: *I think this station is attractive* and *I am willing to stay at this station.*

Safety perception

The construct safety perception consisted of six items (α=.87). For example: *I will feel calm,* and *I will feel at ease.*

Cleanliness

The cleanliness construct consisted of five items (α=.93) with statements such as: *This station looks messy,* and *This station looks well maintained,* and *This station looks clean.*

Association

The construct association consisted of a 5-point semantic differential scale with ten items (α=.92) related to the question: *Which association corresponds best with what you think about the behavior of passengers at this station?* The items were: *Poverty-Wealthy*, and *Crime-No crime.*

Familiarity

The last question corresponding with the first picture consisted the familiarity of the respondents with this station: *Do you know this station?* if yes, *What is the name of the station* and the respondents' travel frequency on this station.

Saliency

The last part consisted a new picture with both types of environmental disorder (Appendix A, photo 2). Two last question were asked about this picture (see Appendix B): *What is the first thing you notice when you look at the picture of this station* and *What would be the first thing you want to change on this station?*

All the items were translated in Dutch for this study.

3.3 Procedure

Respondents were approached through the consumer panel of NS (N=517). An invitation to participate in the online experiment was sent through an e-mail. This e-mail contained a link to the online questionnaire. After the respondents decided to participate and clicked on the link, they were shown a welcome text (See appendix B) and then they were randomly assigned to one of the eight photographs of the station (See appendix A). The different conditions were presented in Table 1. After the respondents had seen the photo, they were sent to the next page on which the survey (Appendix B) started. After finishing the statements, the second picture and two corresponding questions were shown (i.e. station with both environmental disorders present, in second gradation). Once the respondents completed the survey, they were thanked for participation.

Table 1: Study 1 sample

	Litter on the floor			Graffiti			Litter on the floor & Graffiti	Clean
Gradation of the disorders	**1st**	**2nd**	**2nd**	**1st**	**2nd**	**3rd**	**2nd**	
N	N=49	N=66	N=63	N=72	N=65	N=79	N=53	N=70
Mean age	57	59	57	57	61	57	61	60
M/F,	23/23	30/34	28/32	28/38	32/31	40/38	22/29	36/33
M&F	3	1	2	5	2	1	2	1

Note: 1st Gradation: clean except for a few traces of the disorder.

2nd Gradation: litter in concentrate spots, large gaps between piles of the disorders.

3rd Gradation: highly concentrated disorders no gaps in the piles of the disorders.

3.4 Results

The research sample consisted of 517 respondents (N=517). The number of respondents per condition is presented in Table 1. Several constructs were measured in study 1. In this paragraph, the constructs cleanliness, association and saliency were each be evaluated separately. An overview of the mean scores of the first two constructs concerning one of the eight conditions are presented in table 2.

Table 2: Mean scores safety perception, cleanliness and association

	Litter on the floor						Graffiti						Litter on the floor & Graffiti		Clean	
N	1th N=49		2nd N=66		3th N=63		1th N=72		2nd N=65		3th N=79		2nd N=53		N=70	
Construct	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***
Cleanliness**	3.27	.58	3.07	.81	2.03	.73	2.74	.71	2.51	.82	2.44	.78	2.64	.39	3.37	.55
Association**	2.80	.51	2.69	.54	2.26	.46	2.44	.54	2.53	.65	2.49	.54	2.63	.64	2.68	.46

**p<.01

Note: the statements were given in Dutch

Note: 1st Gradation: clean except for a few traces of the disorder.

2nd Gradation: litter in concentrate spots, large gaps between piles of the disorders.

3rd Gradation: highly concentrated disorders no gaps in the piles of the disorders

Cleanliness

An ANOVA (one-way) was performed with the different pictures as independent variable and the overall perceptions of cleanliness as dependent variable, ($F(7,509)=27.16$ $p<.01$). In Figure 4, the difference between the pictures is shown, wherein “LOF&GRAF” represent the “litter on the floor and graffiti” situation. A post hoc analysis showed that the situation with graffiti was evaluated significantly less clean than the situations with litter on the floor and the clean situation ($p<.01$), when environmental disorders are present in the first and second gradation. However, in the third gradation of the disorders (i.e. highly concentrated disorders, no gaps in the piles of the disorders), litter on the floor was significant evaluated less clean than the graffiti and clean situation ($p<.01$). The combined situation was manipulated with the second gradation of the disorders (i.e. litter in concentrate spots, large gaps between piles of the disorders). A post hoc analysis showed that this situation was evaluated significantly less clean than the same gradation of the disorder in the litter situation ($p<.05$). There is no significant different effect between the second gradation of disorders in the graffiti situation compared to the litter on the floor and graffiti situation.

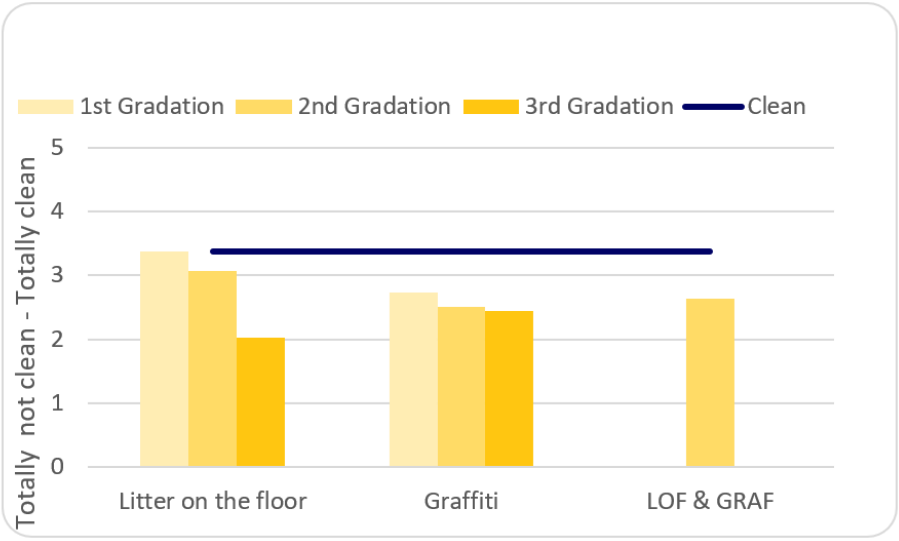


Figure 4: Mean experience of cleanliness

Note: 1=unclean. 5 = clean

Association

The association construct had a lower response (17.4% lower) compared to the other constructs. Moreover, there were several remarks about this question. Many respondents indicated that they were not able to evaluate the behavior of other passengers, based on a picture without passengers. As a result, the question was not filled out or completed completely neutral. Therefore, it is decided not to look at the associations in this study.

Saliency

Saliency was measured by asking the respondents to write down the first thing they saw, when seeing the picture of the combined situation (Picture 2, Appendix A). The open question was coded with five codes (i.e. 1=Graffiti; 2=Litter; 3=LOF&GRAF, trash; 4=Lonely, cold, boring; 5=other), based on the data. After coding, it was significantly found that in almost 50 percent of the cases, graffiti was the given answer $T(508)=33.74$, $p<.01$. Percentages are presented in Figure 5.

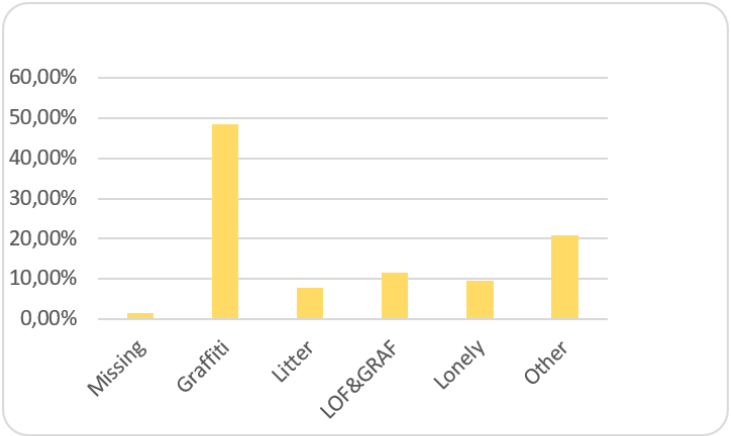


Figure 5: Object saliency

Note: Codes and answers were in Dutch

3.5 Conclusion

One of the aims of this first study was to determine to what extent the railway station should be littered, in order to be perceived as an unclean railway station. For graffiti, all the gradations were judge as unclean (*M*<3). Despite that litter on the floor has not been evaluated in any gradation as clean, only in the third gradation the litter is evaluated as more unclean than clean (*M*<3). In order to ensure an unclean experience of the railway station in the second study to ensure the effects of environmental disorders on attentional engagement and overall evaluation, the second study will use the third gradation of these disorders.

Nevertheless, the construct cleanliness showed that, confirming one part of the first hypothesis, respondents evaluate the train station cleaner in the clean situation, then in the unclean situations. Moreover, the construct cleanliness showed a main effect of litter on the floor and graffiti. Graffiti is experienced less clean than litter on the floor. Remarkable is that litter on the floor is evaluated cleaner when the litter is presented alone, compared to the condition in which the same amount of litter is presented combined with graffiti. For graffiti, there is non-significant difference between the situation graffiti alone and together with litter on the floor, but the mean scores of the cleanliness perception is higher (i.e. cleaner) in the combined situation than in the situation with graffiti alone. It can therefore be suggested that graffiti causes litter on the floor to be experienced more negatively, in contrast, the presence of litter on the floor does not by definition cause graffiti to be experienced as less clean.

The next aim of this study 1 was to determine which disorder is the most salient. Results showed that significantly almost the half of the respondents noticed the graffiti as first thing seen. Hence, the differences in attention to litter on the floor and graffiti as disorders of the environment was proven and can therefore be used in the main study. With the cautious assumption that graffiti is more salient than litter on the floor.

4. Method study 2

Methods employed in the empirical phase of this study were described in this chapter. This chapter contains specific information about the respondents and design for the main experiment (4.1), the procedure of the experiment (4.2), and the measurement techniques (4.3).

4.1 Respondents and design

An experimental study was conducted to test the research questions and hypotheses. Study 1 was done to ensure the amount, the saliency and associations of the several types of environmental disorders. The hypotheses proposed in the theoretical framework were tested with a 2 (Litter on the floor vs. no litter on the floor) x 2 (Graffiti vs. no graffiti) x 2 (passengers current state: waiting vs. walking) between subject UNIANOVA. In this study, the unclean situations were manipulated with litter on the floor and graffiti, according to the results of study 1. The attentional engagement, cleanliness perception and overall station evaluation of the waiting and walking passengers were examined. The study was conducted at the station Enschede Central. The respondents (N= 165) were recruited from the University of Twente (UT), Saxion, and railway passengers who were already at the railway station. None of the respondents participated in study 1. In exchange for participation in this study, respondents received a NS day ticket and course credits.

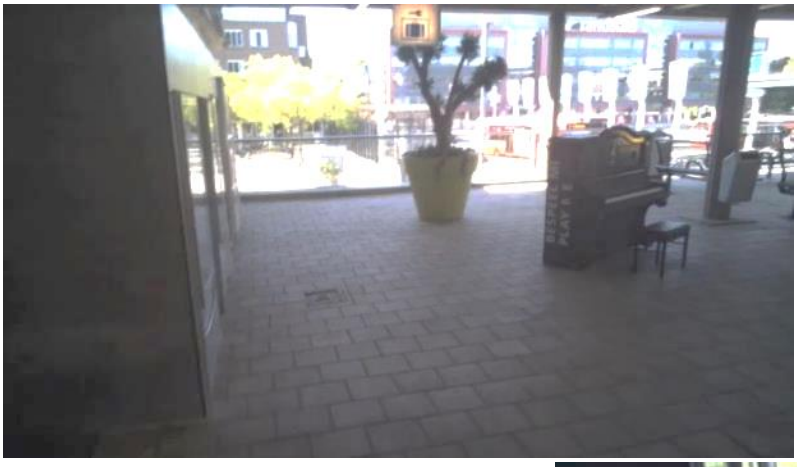
4.2 Procedure

The experiment took place at the railway station Enschede Central. Participants were asked to go to the station Enschede Central on a specific day and time, and randomly assigned to one of the four cleanliness conditions (i.e. clean, litter on the floor, graffiti, litter on the floor and graffiti, see pictures 1-4). The respondents were also randomly assigned to either a waiting or a walking assignment (Appendix C). The study sample is presented in Table 3. The experiment started with information and explanation about the Mobile Eye Tracker. Subsequently, the respondents received a waiting or walking scenario. After reading the scenario, and calibrating the Tobii glasses, the respondents were either waiting next to the lockers or walking along the lockers on the left side of the station for half a minute.

After completing the experimental part of this study, respondents were asked to fill out a short questionnaire (Appendix D).

Table 3: Study 2 sample

	Clean		Litter on the floor		Graffiti		LOF&GRAF		Total
	Waiting	Walking	Waiting	Walking	Waiting	Walking	Waiting	Walking	
N	N=23	N=20	N=20	N=21	N=20	N=20	N=20	N=21	N=165
Mean age	24	22	23	27	26	26	24	21	24
M/F	11/11	11/9	5/14	3/18	8/12	5/15	12/8	13/8	69/95
missing	1		1						2



Picture 1: Clean situation

Picture 2: Litter on the floor situation

Picture 3: Graffiti situation

Picture 4: Litter on the floor and Graffiti situation

4.3 Measurement techniques

Study 2 consisted of two parts. The first part of the study was related to observations with the mobile eye-tracking glasses, part two consisted a questionnaire. The methods for both parts of the study will be explained in this paragraph. Starting the mobile eye tracking glasses (4.3.1), followed by the questionnaire (4.3.2). The results of both parts will be presented in the next chapter (5. Results study 2).

4.3.1 Mobile eye tracking

The main research method of this study was the experiment with the Mobile Eye Tracker (MET) Tobii Pro Glasses 2 (Figure 6, University of Twente's BMS Lab). The MET was used to discover differences in attentional engagement towards different environmental disorders (i.e. litter on the floor and graffiti). Eye tracking technology records the eye movements (i.e. overt visual attention), whether conscious or unconscious, and distinguishes fixations from saccades. This makes it possible to evaluate the correlations between the observed patterns, meanings and the goals of attention (Eghbal-Azar, & Widlok, 2013). Mayr et al., (2009) [cited by Eghbal-Zar, & Widlok, 2013] mentioned four benefits of MET as a recording device:

- Data richness (through the inclusions of information about the environment)
- High external data validity (because data are recorded objectively by cameras)
- Providing a nonreactive measurement (because eye movements can hardly be manipulated due to its unconsciousness)
- Allowing statistical analysis again and again quantitatively or qualitatively

Figure 6: Tobii Pro Glasses 2.

Analysis Tobii glasses

The data of the eye tracking glasses was analyzed using the Tobii Pro Lab and SPSS.

First, the eye tracking data was analyzed in the Tobii Pro Lab. Each interesting fixation point was indicated in a picture of the manipulated part of the railway station. A fixation point was interesting once the point was in one of the areas of interest. The areas of interest are indicated as areas related to the litter on the floor or to the graffiti, using the Tobii Pro Lab. Figure 7 showed the railway station in the situation with litter on the floor and graffiti, with the related areas of interest.

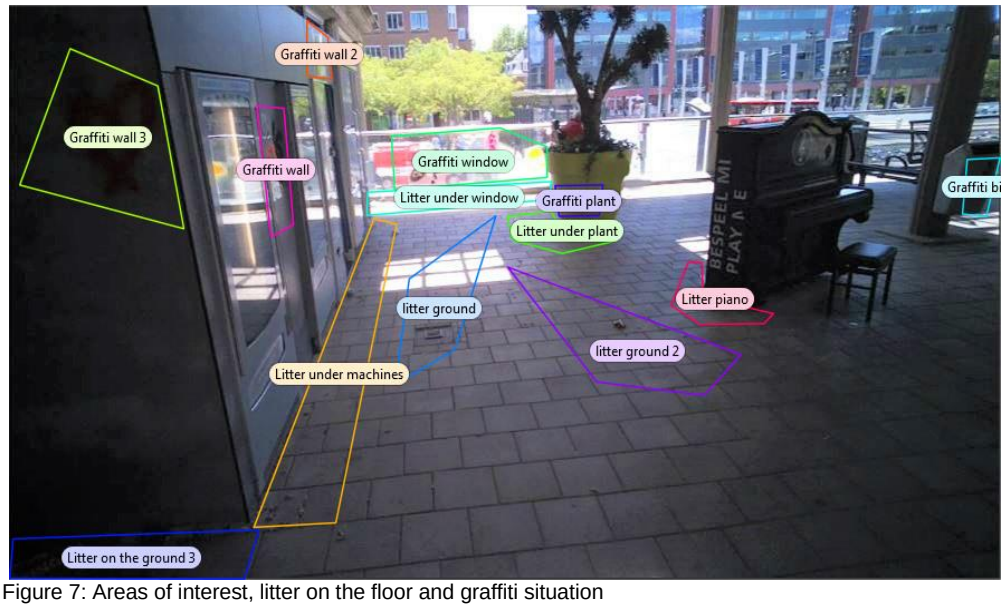


Figure 7: Areas of interest, litter on the floor and graffiti situation

Due to high standard deviations and high kurtosis, data was Cube Root transformed to obtain a normal distribution (Lanktree, Hegele, Schork, & Spence, 2010). Table 4 gives an overview of the means and standard deviations before and after the Cube Root-transformation for the dependent variables that will be used in the result section.

Table 4: Means and standard deviations before and after Cube Root-transformation

		Total fixation duration Litter on the floor	Total fixation duration Graffiti	Total fixation count Litter on the floor	Total fixation count Graffiti
	N	165	165	165	165
	M	1.38	2.51	4.14	6.09
Before	**SD**	2.27	4.56	5.70	6.19
transformation	**Skewness**	3.49	2.13	3.96	5.84
	Kurtosis	19.02	6.24	22.55	48.16
	N	165	165	165	165
After	**M**	.81	1.08	1.23	1.57
CubeRoot	**SD**	.57	.60	.80	.72
transformation	**Skewness**	.20	.46	-.15	-.57
	Kurtosis	-.29	1.29	-.49	.46

4.3.2 Questionnaire

Mayr at al. (2009) suggest combining MET with other methods to gain valid interpretations of scan patterns. That is why the observations with the MET in this study were supplemented with a short questionnaire, completed by the respondents after the observation. The questionnaire consisted of several dependent variables that measured the respondents' attention and emotions under various conditions of cleanliness and passenger's current state. The questionnaire is included in Appendix D. The constructs of the questionnaire are discussed in this paragraph.

Saliency

First, the saliency of the manipulated objects cleanliness and graffiti were measured. The saliency construct consisted of one question: *What was the first thing you saw when entering the platform?*

Emotions

Second, the questionnaire (Appendix D) consisted of constructs regarding the environmental experience. Subjects' environmental experience was measured using the PAD-emotions (Mehrabian & Russel, 1974). The PAD-emotions consist of three constructs, that is: pleasure, arousal and dominance. Each emotional dimension was measured with items using a 5-point semantic differential scale of Mehrabian and Russel (1974). One item was emitted from the 'pleasure construct' (i.e. strained-relaxed) to improve the Cronbach's alpha. Five items are used (α=.61) consisted items such as *unsatisfied-satisfied*. Four items were emitted from the 'arousal construct' (i.e. annoyed-comfortable, exited-calm, reared-listless, alert-slow) to improve the Cronbach's alpha. The remaining two items (α=.62) consisting: *bored-stimulated,* and *sleepy-energetic.* Four items were also emitted from the 'dominance construct' (i.e. guided-independent, impressionable-influential, weighty-unimportant, dominant-submissive) to improve the Cronbach's alpha. The remaining two items (α = .61) consisting: *compassionate-leading,* and *following-steering.*

Cleanliness

Third, the perceived cleanliness was measured with four items (α=.87) retrieved from Vos (2015) and Gostelie (2017), and consisting of a 5-point Likert scale ranging from *totally disagree* to *totally agree*. Sample items are: *The station platform seems messy* and *The station seems neat*. Two items were emitted from the 'cleanliness construct' (i.e. the station seems to meet my wishes/well maintained) to improve the Cronbach's alpha.

Association

As fifth construct, the associations about the behavior of other passengers at the railway station was measured. Based on the results of study 1, the semantic different scale concerning the association is redesigned in a 5-point Likert scale, with ten items. After a reliability check, eight items were deleted (α =.90). The remaining items consisted: violence, and *aggression*, concerning the question: *At this station, there are outings I associate with.*

Attention

As fifth, the questionnaire (Appendix D) consisted of the construct regarding the remembered attention that is spent on the manipulated objects. A semantic different scale was designed for this study, concerning the question: *To what extent have you seen the following objects on the platform?* Eight objects were given, consisting a 5-point Likert scale ranging from *not at all* to *very much*.

Demographic variables

The last part of the questionnaire consisted several general variables regarding respondents' travel frequency and demographic variables such as *gender* and *age*, to indicate the descriptive variables of the respondents.

Covariates

Four covariates are monitored during the experiment. Density was subdivided into eight different density levels (i.e. 0, 1-5, 6-10, 11-15, 16-20, 21-25, 26-30, 30+). Time of the day was noted. Weather was subdivided into twelve different weather conditions (i.e. sunny, sunny with little clouds, sunny with clouds, clouds, little rain, raining, downpour, lighting storm, dark clouds, little bit of snow, snowing and windy).

5. Results study 2

The results of study 2 will be discussed in this chapter. Based on the research design (Figure 3), the effect of unclean disorders and current state of passengers on attentional engagement, the cleanliness perception and overall station evaluation will be discussed. Paragraph 5.1. focusses on the results of the eye-tracking glasses. Paragraph 5.2 focusses on the outcomes of the UNIANOVA analysis of the questionnaire, and paragraph 5.3 focusses on the regression analysis between the eye-tracking and the questionnaire. The research sample consisted of 165 respondents (N=165). The number of respondents per condition were included in Table 3.

5.1 Results Eye-tracking

The first part of the experiment consisted of an eye-tracking study. The Mobile Eye Tracker (MET) was used to discover differences in attentional engagement towards different unclean disorders (i.e. litter on the floor and graffiti) in specific areas of interest (AOI's). There were many objects for respondents to look at, since the respondents were in a real train station (Central station of Enschede). Therefore, the standard deviation of the areas of interest are widely spread. A CUBE Root-transformation was conducted in order to correct the violation of assumption of homogeneity of variance (see Table 4). UNIANOVA analysis showed several main and interaction effects of litter on the floor (i.e. littered or clean), graffiti (i.e. graffiti or clean), and current state passengers (i.e. waiting or walking) on the attentional engagement (i.e. fixation count and fixation duration) of the respondents (see Table 5). The total fixations count per area of interest consisted of the total amount of fixations per area of interest. Analyses were done after all areas of interest for litter were computed and all areas of interest for graffiti were computed, and performing the Cube Root transformation. The same goes for total duration of the fixations. In other words, how long did respondents look to the areas of interest. Analyses are done after compute all the areas of interest concerning litter on the floor in one total duration time, all the areas of interest concerning graffiti in one total duration time, and Cube Root transformation. Next, the significant main and interaction effects of litter, graffiti and state of the passengers on attentional engagement are discussed.

5.1.1 Litter on the floor

UNIANOVA analysis showed a statistical significant main effect of the cleanliness condition litter on the floor on the total fixation count to litter $F(1,157)=48.88$, ($p=.00$). In the conditions with litter on the floor there are significantly more fixations to litter areas ($M=1.62$, $SD=.62$) than in the no litter conditions ($M=.87$, $SD=.78$). Also on the total fixation duration concerning litter areas, the littered condition showed a main effect $F(1,157)=49.43$, ($p=.00$). In the situation with litter on the floor, fixations to litter take significant longer ($M=1.09$, $SD=.47$) compared to situations without litter ($M=.55$, $SD=.53$).

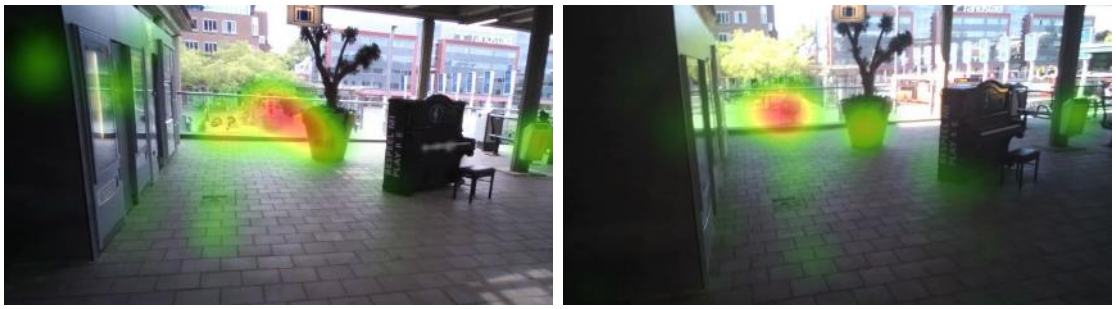
Table 5: Main and interaction effect of litter on the floor, graffiti and current state on dependent variables of the mobile eye-tracker

		F	*df*	*p*	*T*
Main effects					
Litter on the floor	Fixation count litter**	48.88	1,157	.00	
	Fixation duration litter**	49.34	1,157	.00	
	Fixation count graffiti	.11	1,157	.74	
	Fixation duration graffiti	.14	1,157	,71	
Graffiti	Fixation count litter	.12	1,157	.73	
	Fixation duration litter	.07	1,157	.79	
	Fixation count graffiti**	16.84	1,157	.00	
	Fixation duration graffiti**	46.75	1,157	.00	
Current state passengers	Fixation count litter	3.42	1,157	.07	
	Fixation duration litter*	6.14	1,157	.01	
	Fixation count graffiti	2.53	1,157	.11	
	Fixation duration graffiti*	5.39	1,157	.02	
Interaction effects					
Litter on the floor * Graffiti	Fixation count litter*	4.05	1,157	.046	
	Fixation duration litter	3.23	1,157	.07	
	Fixation count graffiti	.39	1,157	.54	
	Fixation duration graffiti	.02	1,157	.89	
Litter on the floor * Current state passengers	Fixation count litter	1.71	1,157	.19	
	Fixation duration litter	.35	1,157	.56	
	Fixation count graffiti	2.26	1,157	.14	
	Fixation duration graffiti	2.96	1,157	.09	
Graffiti * Current state passengers	Fixation count litter	.95	1,157	.33	
	Fixation duration litter	.65	1,157	.42	
	Fixation count graffiti	1.60	1,157	.21	
	Fixation duration graffiti	1.29	1,157	.26	
Litter on the floor * Graffiti * Current state passengers	Fixation count litter	1.24	1,157	.27	
	Fixation duration litter	.93	1,157	.34	
	Fixation count graffiti*	3.94	1,157	.049	
	Fixation duration graffiti*	4.32	1,157	.04	
Paired sample t-test (Litter on the floor and graffiti)	Fixation count**		121	.01	3.135
	Fixation duration***		121	.00	3.584
ONE-WAY ANOVA (Waiting and walking passengers)	Fixation count***	10.98	1,121	.00	
	Fixation duration***	14.66	1,121	.00	

****p=.00*
***p<.01*
**p<.05*

5.1.2 Graffiti

UNIANOVA for the total fixation count of graffiti, showed a significant main effect of the cleanliness conditions with graffiti $F(1,157)=43.03$, ($p=.00$). Respondents fixated significant more often to graffiti in the graffiti situations ($M=1.91$, $SD=.57$) than in the situations with no graffiti ($M=1.27$, $SD=.69$). This is visualized in the heatmaps below (Heatmaps 1).



Heatmaps 1: Total fixation count, graffiti situation (Left), total fixation count, clean situation (Right)
Note: ranging from green (few fixations) to red (a lot of fixations)

UNIANOVA analysis showed on the total fixation duration concerning graffiti a significant main effect of the graffiti $F(1,157)=46.75$, ($p=.00$). The fixations to graffiti lasted longer in the graffiti situations ($M=1.37$, $SD=.56$) than in the situations without graffiti ($M=.81$, $SD=.50$).

5.1.3 Current state passengers

The current state of the respondents showed a significant main effect $F(1,157)=6.14$, ($p<.05$) on the total fixation duration concerning litter on the floor. Consisting longer fixations when waiting ($M=.91$, $SD=.63$), compared to walking ($M=.73$, $SD=.50$). The differences in fixation duration between waiting and walking respondents is visualized in the heatmaps below (Heatmaps 2).

Heatmaps 2: Total fixation duration litter on the floor, waiting passengers (Left), walking passengers (Right).
Note: ranging from green (short duration) to red (long duration)

The current state of the passengers showed also a main effect $F(1,157)=5.39$, ($p<.05$) on the total fixation duration to graffiti, with a longer fixation to graffiti by waiting passengers ($M=1.18$, $SD=.67$) compared to walking passengers ($M=1.00$, $SD=.52$). This is visualized in the heatmaps below (Heatmaps 3).

Heatmaps 3: Total fixation duration graffiti situation, waiting passengers (Left), walking passengers (Right).

Note: ranging from green (short duration) to red (long duration)

5.1.4 Interaction effects

Analysis showed an interaction effect between the litter and graffiti on the total fixation count concerning litter areas $F(1,157)=4.05$, ($p<.05$) (Figure 8). The interaction effect shows that the number of fixations on litter on the floor decreases significantly in the combined situation ($M=1.49$, $SD=.59$) compared to situations with only litter on the floor ($M=1.74$, $SD=.63$). Heatmaps 4 shows the situation with only litter on the floor and the situation with both environmental disorders (Heatmaps 4).

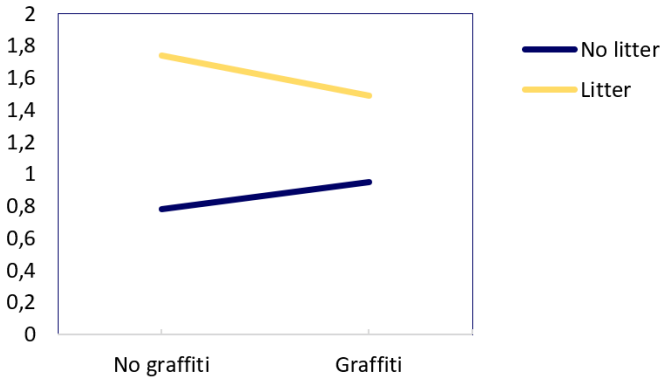


Figure 8: Interaction cleanliness conditions on total fixation count concerning litter on the floor

Heatmaps 4: Total fixation count, litter on the floor (left) and total fixation count, LOF&GRAF (right)

Note: ranging from green (few fixations) to red (a lot of fixations)

On the total fixation count to graffiti, UNIANOVA showed a three-way interaction effect between the cleanliness conditions and the current state of the passengers $F(1,157)=3.94$, ($p<.05$) (Figure 9). In the cleanliness situation with no litter on the floor, there were more fixations to graffiti in the graffiti situation ($M=2.06$, $SD=.70$) compared to clean situation ($M=1.16$, $SD=.81$) for waiting passengers ($p=.00$). The same situation is non-significant for walking passengers ($p>.1$). In the litter on the floor conditions, there are more fixations to graffiti in the graffiti situation ($M=2.04$, $SD=.59$) than in the situations without graffiti ($M=1.41$, $SD=.71$), when passengers are waiting ($p<.01$). The same goes for walking passengers in de situation with litter on the floor and with graffiti ($M=1.81$, $SD=.38$) and without graffiti ($M=1.04$, $SD=.57$) ($p=.00$). In other words, there is an interaction effect between the cleanliness conditions and the current state. Which means that respondents fixated more often to graffiti areas when there is graffiti, but no litter on the floor and passengers are waiting, and more often to graffiti areas in the combined situation compared to the situation with only litter on the floor and respondents both walk and wait.

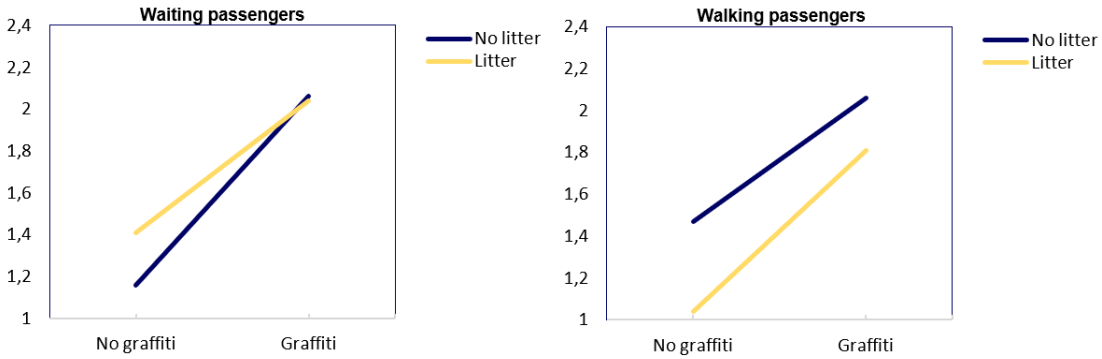


Figure 9: Interaction effect cleanliness conditions and current state on total fixation count graffiti

The cleanliness conditions and the current state of the passengers showed also a three-way interaction effect on the total fixation duration to graffiti areas $F(1,157)=4.32$, ($p<.05$). In situations without litter on the floor, fixations to graffiti takes longer in the situation with graffiti ($M=1.54$, $SD=.60$) compared to situations without graffiti ($M=.72$, $SD=.58$) for waiting passengers ($p=.00$). In the littered conditions, the fixations take also longer in the graffiti situation ($M=1.47$, $SD=.58$) compared to situation without graffiti ($M=1.01$, $SD=.56$) and waiting behavior ($p<.01$). The same goes for walking passengers in the situations with litter and with graffiti ($M=1.22$, $SD=.31$) compared to litter but without graffiti ($M=.60$, $SD=.36$) ($p=.00$). In other words, waiting passengers have longer fixations to graffiti, when there is graffiti compared to non-graffiti situations in situation without litter. When there is litter on the floor, both waiting and walking passengers have longer fixations to graffiti, when there is graffiti compared to non-graffiti situations.

Litter on the floor compared to graffiti

A paired-samples t-test was conducted to compare the number of fixations to litter on the floor and to graffiti. There were significant more fixations to graffiti (*M*=1.68, *SD*=.68) than to litter on the floor (*M*=1.40, *SD*=.76); t(121)=-3.135 (*p*<.01). The same test was conducted to compare the total time of fixations to litter on the floor and to graffiti. There were significant longer fixations to graffiti (*M*=1.18, *SD*=.61) than to litter on the floor (*M*=.93, *SD*=.55); t(121)=-3.584 (*p*=.00).

Waiting passengers compared to walking passengers

A ONE-WAY ANOVA was conducted to compare the number and total duration of the fixations to environmental disorders of waiting passengers and walking passengers. There were significant more (*M*=2.31, *SD*=.64) fixations by waiting passengers, compared to walking passengers (*M*=1.96, *SD*=.50), *F*(1,121)=10.98, (*p*=.00). Waiting passengers (*M*=1.66, *SD*=.56) had also a longer fixation duration to the environmental disorders, compared to walking passengers (*M*=1.30, *SD*=.49), *F*(1,121)=4.05, (*p*=.00).

5.1.5. Covariates on fixation count and fixation duration and demographic variables

The four covariates in this study, density, time of the day, railway station familiarity and weather showed only a statistical significant main effect of the *density level* on the dependent variables *total fixation count* and total *fixation duration*. Post hoc analysis showed significant differences between the density levels 1-5 and 11-15, 1-5 and 16-20 (on fixation count: litter on the floor), density levels 1-5 and 16-20, 16-20 and 30+ (on fixation duration: litter on the floor), and between 16-20 and 26-30, 21-25 and 26-30 (on fixation duration: graffiti). The difference is mainly found between the different levels of density in combination with the situation with 16-20 other passengers present at the railway station. With the main score on the total fixation count and total fixation duration lower in the situation with 16-20 other passengers at the railway station. Therefore, it can be concluded that when 16-20 other passengers are present at the railway station, passengers are distracted from unclean disorders. Analysis showed non-significant main effects of the other covariates, as even non-significant interaction effect of all covariates on the total fixation count and fixation duration.

The demographic variables consisted of two questions related to gender and age. ANOVA analysis showed non-significant main effect or interaction effects between the demographic variables and the total fixation count/duration of both, litter on the floor and graffiti areas of interest.

To summarize, the formulated hypothesis (Figure 3) refer to expectations regarding the effects of the cleanliness situations and the current states of the passengers on attentional engagement, the cleanliness perception and overall station evaluation. The total fixations per area of interest and the total duration of the fixations per area of interest showed significant main effects of the unclean disorder types and the corresponding dependent variable. The current state of the passengers seems to have a considerable influence on the total fixation durations. In other words, waiting or walking influences the total time that passengers look to unclean disorders. After analysis concerning the fixations of the passengers, the question remains how passengers perceive the railway station. Hence, several 2x2x2

UNIANOVA's concerning the questionnaire part of this study, were performed. The UNIANOVA's were performed in order to find main and interaction effects between the cleanliness conditions of the railway station and the current state of the passengers on the dependent variables pleasure, arousal, dominance, cleanliness, association and remembered attention to unclean disorders. The results are presented in the next paragraph.

5.2 Results Questionnaire

The questionnaire consisted of eight constructs and the demographic questions, as explained in 4.3.2. A manipulation check with ANOVA and post-hoc analyses, and UNIANOVA analyses were performed and explained in this paragraph.

5.2.1 Manipulation check

First, the manipulation check was conducted for the questionnaire for study 2 related to the respondents' perception of cleanliness. In order to verify perceptions of cleanliness during the experiment a one-way ANOVA was used. The ANOVA indicated a significant effect between the cleanliness conditions $F(3,157)=4,75$, ($p<.01$). Post Hoc analysis showed that the clean condition is being perceived as significantly cleaner ($M=3.63$, $SD=.66$) than the litter on the floor condition ($M=3.05$, $SD=1.00$) ($p<.01$), and the combined condition ($M=3.09$, $SD=.80$) ($p=.01$) (Table 6). Surprisingly, post hoc analysis showed non-significant differences in the graffiti condition compared to the other conditions.

Table 6: Mean score, standard deviation per cleanliness condition

	Clean			Litter on the floor			Graffiti			LOF&GRAF		
	N	**M**	**SD**	**N**	**M**	**SD**	**N**	**M**	**SD**	**N**	**M**	**SD**
Perception of cleanliness	42	3.63	.66	39	3.05	1.00	40	3.37	.67	40	3.09	.80

Note: 5=Clean, 1=Unclean

5.2.2 UNIANOVA

As the starting point of the analysis of the questionnaire of study 2, the effect of the current state of the passengers on the dependent variables, is examined under various conditions of cleanliness. Several 2x2x2 UNIANOVA's are performed in order to detect possible main effects and interaction effects (see table 7). The results for significant dependent variables (i.e. pleasure, dominance, cleanliness and remembered attention to unclean disorders) are described in this paragraph.

Table 7: Main and interaction effect of litter on the floor, graffiti and current state on dependent variables of the questionnaire

		F	*df*	*p*
Main effects				
Litter on the floor	Pleasure	.01	1,157	.93
	Arousal	.07	1,154	.80
	Dominance	.42	1,154	.52
	Cleanliness***	11.41	1,153	.00
	Association	.00	1,153	.98
	Remembered attention***	23.22	1,145	.00
Graffiti	Pleasure*	4.38	1,157	.04
	Arousal	1.05	1,154	.31
	Dominance	.75	1,154	.39
	Cleanliness	.72	1,153	.40
	Association	.00	1,153	.98
	Remembered attention**	6.99	1,145	.01
Current state passengers	Pleasure	.02	1,157	.90
	Arousal	.34	1,154	.56
	Dominance*	4.93	1,154	.03
	Cleanliness	.24	1,153	.63
	Association	.17	1,153	.67
	Remembered attention*	3.95	1,145	.05
Interaction effects				
Litter on the floor * Graffiti	Pleasure	1.26	1,157	.26
	Arousal	1,42	1,154	.24
	Dominance	1,74	1,154	.19
	Cleanliness	1.40	1,153	.24
	Association	.07	1,153	.80
	Remembered attention	2.77	1,145	.10
Litter on the floor * Current state passengers	Pleasure	.22	1,157	.64
	Arousal	.01	1,154	.92
	Dominance	.04	1,154	.83
	Cleanliness	.13	1,153	.72
	Association	.25	1,153	.62
	Remembered attention	.26	1,145	.61
Graffiti * Current state passengers	Pleasure*	4.36	1,157	.04
	Arousal	.23	1,154	.64
	Dominance	.30	1,154	.59
	Cleanliness	.00	1,153	1.00
	Association	.04	1,153	.84
	Remembered attention*	4.43	1,145	.04
Litter on the floor * Graffiti * Current state passengers	Pleasure	.00	1,157	1.00
	Arousal	.59	1,154	.45
	Dominance	1.49	1,154	.22
	Cleanliness	1.29	1,153	.26
	Association	1.08	1,153	.30
	Remembered attention**	7.11	1,145	.01

***p=.00
**p<.01
*p<.05

Pleasure

An UNIANOVA showed a statistical significant main effect of graffiti $F(1,149)=4.38$, ($p<.05$). Respondents have more pleasure when there is no graffiti ($M=3.42$, $SD=.45$), than when there is graffiti at the railway station ($M=3.33$, $SD=.53$). UNIANOVA showed a significant interaction effect between the graffiti and the state of the passengers (i.e. waiting or walking) on pleasure $F(1,149)=4.36$, ($p<.05$) (Figure 10). Only for respondents who are walking the presence of graffiti had a negative effect on pleasure $F(1,149)=9.06$, ($p<.01$). The effect was non-significant for waiting passengers ($p>.10$).

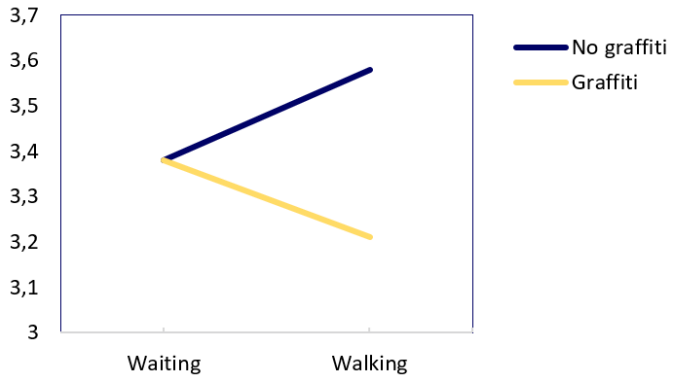


Figure 10: Differences between current state of passengers on pleasure under various graffiti conditions

Dominance

The current state of the passengers showed a significant main effect on dominance $F(1,154)=4.93$, ($p<.05$). With more perceived dominance by walking passengers (M=2.98, SD=.83) compared to waiting passengers (M=2.70, SD=.83).

Cleanliness

An UNIANOVA showed a significant main effect of litter on the floor on the cleanliness perception $F(1,153)=11.41$, ($p=.01$). Respondents perceive the railway station significant cleaner when there is no litter on the floor ($M=3.63$, $SD=.66$) than when there is litter on the floor (M=3.05, $SD=1.00$).

Remembered attention to unclean disorders

As presented in table 7, three main effects were found for the remembered attention to unclean disorders. Respondents remembered significant more unclean disorders in the situation with litter ($M=1.96$, $SD=.58$) compared to the situation without litter ($M=1.55$, $SD=.53$), $F(1,145)=23.22$, ($p=.00$). Respondents remembered in the graffiti conditions more unclean disorders ($M=1.87$, $SD=.56$) compared to the no graffiti situations ($M=1.64$, $SD=.59$), $F(1,145)=6.99$, ($p<.01$), and respondents who were walking remembered significant more unclean disorders ($M=1.85$, $SD=.62$) than respondents who were waiting ($M=1.66$, $SD=.54$) $F(1,145)=3.95$, ($p<.05$). UNIANOVA analysis found a significant interaction effect between the graffiti conditions and the state of passengers $F(1,145)=4.43$, ($p<.05$) (Figure 11). Only for passengers who were walking the presence of graffiti had effect on the remembered attention to unclean disorders $F(1,145)=11.36$, ($p<.01$), with more unclean disorders remembered in the graffiti situation ($M=2.05$, $SD=.59$), compared to the clean situation ($M=1.66$, $SD=.59$). The effect was non-significant for waiting passengers ($p > .10$).

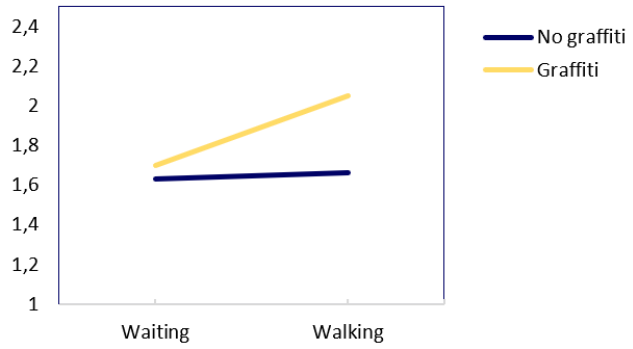


Figure 11: Differences between state of passengers on remembered attention to unclean disorders under various graffiti conditions

Finally, table 7 showed a three-way interaction of the cleanliness and the state of the passengers on the remembered disorder attention, $F(1,145)=7.11$, ($p<.01$) (Figure 12). Waiting passengers remembered significant more disorders in the littered situation ($M=2.06$, $SD=.61$) compared to the clean situation ($M=1.25$, $SD=.22$) ($p=.00$). For the graffiti situation or the combined situation, non-significant results were found for waiting passengers on the remembered attention to unclean disorders. Walking passengers remembered significant more disorders in the litter condition ($M=1.79$, $SD=.62$) than in the clean condition ($M=1.51$, $SD=.54$) ($p<.10$). Moreover, walking passengers remembered more environmental disorders in the combined situation ($M=2.27$, $SD=.54$) compared to the situation with only graffiti ($M=1.82$, $SD=.56$) ($p<.01$).

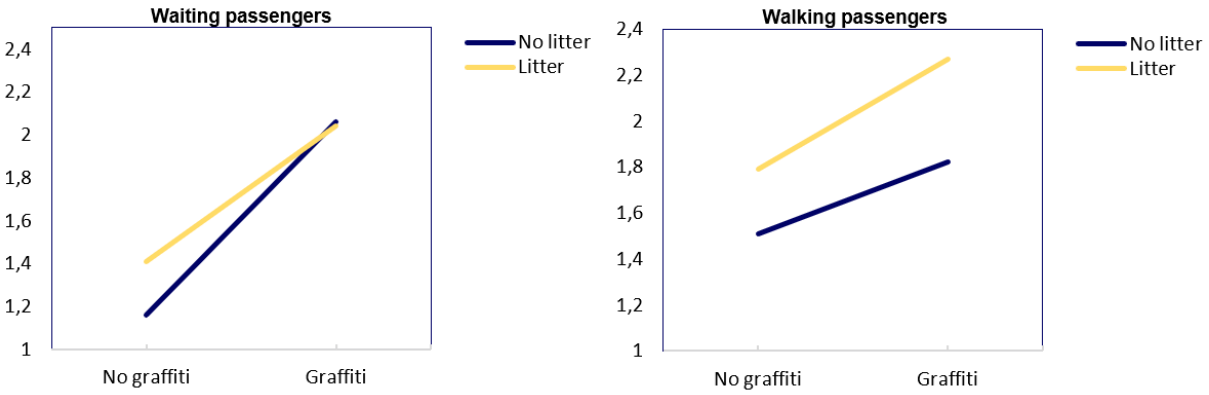


Figure 12: Interaction effect between means remembered unclean disorders per cleanliness condition, per current state

Covariates on dependent variables of the questionnaire

The four covariates in this study, density, time of the day, railway station familiarity and weather, showed only a main effect of *railway station familiarity* on the dependent variable *remembered attention to unclean disorders* ($F(4,148)=5.40$, $p<.001$). With more remembered attention to environmental disorders when respondents travel 4 days per week or more with the train from Enschede Central. Which mean that if passengers travel often with the train, they think to remember more environmental disorders, than passengers who travel less from this railway station. The other covariates showed non-significant main effects or interaction effects on the dependent variables in the questionnaire.

Demographic variables

Analysis showed non-significant main effects or interaction effects of the demographic variables on the dependent variables in this questionnaire.

To summarize, the formulated hypothesis (Figure 3) refer to expectations regarding the effects of the cleanliness situations and the current states of the passengers on attentional engagement, the cleanliness perception and overall station evaluation. The dependent variables pleasure, cleanliness and remembered attention to environmental disorders showed statistical significant main effects of the cleanliness conditions and the current states of the passengers. The dependent variables pleasure and remembered attention to unclean disorders showed also statistical significant interaction effects between the cleanliness conditions and the current state of the passengers. Thus, the current state of the railway station (i.e. clean or unclean) and the current state of passengers (i.e. waiting or walking), influence the pleasure, perceived cleanliness, and the remembered attention to environmental disorders.

5.3 Regression analysis eye-tracking and questionnaire

A simple linear regression was calculated to predict the cleanliness perception based on fixation count, fixation duration and pleasure (Figure 13). A significant relationship was found for fixation count $F(1,159)=6.35$, ($p=.01$), with an R^2 of .038. Participant's average cleanliness perception decreased .24 for each evaluation point of cleanliness (ranging from 1 = unclean to 5 = clean). In addition, pleasure was significantly related to perceived cleanliness as well $F(1,153)=12.94$, ($p=.00$), with an R^2 of .078. Participant's average cleanliness perception increased .41 for each evaluation point of cleanliness (ranging from 1 = unclean to 5 is clean). Fixation duration is not significantly related to the perceived cleanliness perception.

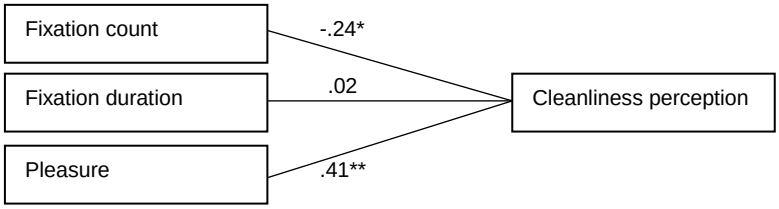


Figure 13: Regression fixation count/duration and pleasure on cleanliness perception

The impact of all these results on the assumed hypothesis and questions, as well as the conclusions and implications of both studies, will be discussed in the next chapter.

6. Conclusion and discussion

This study focused on the attentional engagement of passengers towards several types of environmental disorders (i.e. litter on the floor, graffiti) under various conditions of cleanliness and current state of the passengers, whereby the travel experience was divided into the cleanliness perception (i.e. cleanliness evaluation and remembered unclean disorders) and station evaluation (i.e. pleasure, arousal, dominance). The first study gathered information about the difference in saliency of the two environmental disorders and showed already an influence of the environmental disorders on cleanliness perception. The second study measured the attentional engagement of the passengers towards environmental disorders in four different cleanliness conditions, based on the results of the first study. The results and implications of both studies are discussed here. The objective of this study was to examine the attentional engagement of passengers towards different environmental disorders, under various conditions of cleanliness and current state of the passengers, and the influence of these disorders on the cleanliness perception and overall station evaluation to (dis) confirm the formulated hypotheses (Figure 13), give an answer to question 1, and to the main-, sub question:

Main question: *"What is the influence of several types of unclean environmental disorders (litter or graffiti) in a railway station on the passengers' attentional engagement and overall station evaluation?"*

Sub question: *"What is the influence of the passengers' current state (waiting or walking), on the process of visual environmental disorder attention?"*

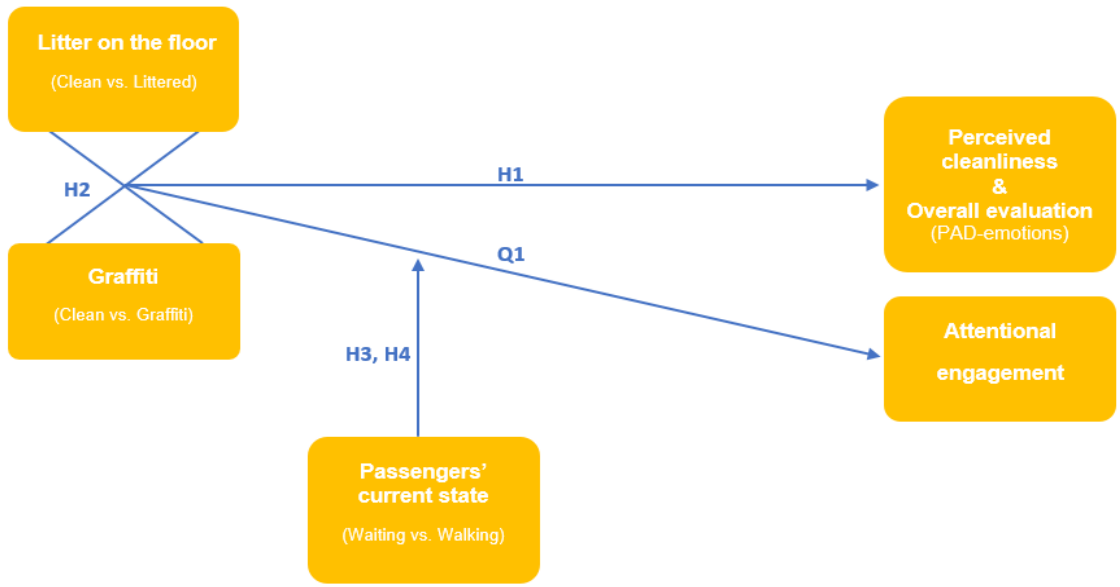


Figure 13: Theoretical model for the current study

In this final chapter, the main findings are presented in relation with the used literature (6.1). Followed by the general conclusion (6.2) and the recommendations for future research (6.3). The chapter is concluded with the practical recommendations for NS (6.4).

6.1 Main findings

The main findings are presented here following the same structure as the theoretical framework section.

Hypothesis 1: Passengers evaluate the railway station more clean and pleasurable in the clean situation, than in the unclean situation. (Partly approved)

Cleanliness is one of the most valuable aspects of environment experiences (Wakefield, & Blodgett (1996); Celik et al., 2014; Eboli, & Mazzulla, 2015; Goel et al., 2016). Moreover, uncleanliness can be defined as disorder of the environment (Keizer et al., 2008; Smith, & Cornish, 2006), and because of the purpose of the NS to provide their customers a comfortable journey and the opportunity to spend time on clean train stations, passengers expect train stations to be clean. Together, leading to uncleanliness a dissatisfier. Uncleanliness at a railway station has therefore a negative impact on the passengers' evaluation. This is reflected in the results. The first study showed a less clean evaluation of the railway station with unclean environmental disorders (i.e. litter on the floor and/or graffiti) compared to a clean railway station, regardless the amount of these disorders. The second study showed the same result. The unclean situations are evaluated as less clean than the clean situation. Moreover, the second study, passengers experienced more pleasure in the situations with no graffiti, compared to the situations with graffiti. Surprisingly, litter does not affect the perceived pleasure. Combining the literature and the results of both studies, hypothesis one can be confirmed concerning the cleanliness perception. The pleasure part of the hypothesis can only be confirmed concerning graffiti. More research is necessary to evaluate the influence of these environmental disorders on emotion. Nevertheless, the fact that pleasure is only affected by the graffiti in this study, suggests that there is a difference in litter and graffiti, what seems to indicate an answer to question 1:

Question 1: Which unclean environmental (i.e. litter on the floor or graffiti) disorder will receive the most attentional engagement?

Question 1 concerns the attentional engagement, in other words a combination of the fixation count and fixation duration to the environmental disorders. Following the bottom-up theory, graffiti should receive more attentional engagement than litter on the floor. According the top-down theory it remains unclear which environmental disorder will receive the most attentional engagement. The first study has proven that graffiti is more salient than litter on the floor. Almost half of the respondents indicated graffiti as the first thing seen when looking to a picture of the combined situation. Looking to the total number of fixations and total fixation durations to uncleanliness in the second study, it has been proven that passengers have more attentional engagement for graffiti than for litter. Therefore, it can be concluded that graffiti received more attentional engagement. The reason could be that graffiti can also be seen as a form of art (Thompson et al., 2012). The attention is being drawn by the graffiti because people like it. However, it remains unclear why graffiti is getting more attention. In both studies, the association question did not contain validity and reliability. So, the question remains why graffiti received the most attentional engagement, by saliency or by underlying thoughts.

Nevertheless, it has become clear that, regardless bottom-up or top-down theory, graffiti has a stronger impact on attention than litter, which partly leads to the argumentation for accepting the second hypothesis:

Hypothesis 2: There is an interaction effect between litter on the floor and graffiti, that influence the attention. Whereby the presence of litter on the floor reinforces graffiti attention, and vice versa. (Partly approved)

Hypothesis 2 assumed to be correct according to the competition regarding the intensive observing of objects, that can be won by just one object (Kastner, & Ungerleider, 2000; Buschman, & Miller, 2007). There is indeed one environmental disorder that receive the most attentional engagement and therefore wins the competition. As explained before, there is a difference between litter on the floor and graffiti. The first study showed a one-tailed interaction effect between litter on the floor and graffiti, wherein graffiti affect litter on the floor to be experienced more negatively. In other words, litter is evaluated cleaner in the litter condition, compared to the combined condition. This effect has not been found the other way around. The second study showed the same results. In the combined situation the total number of fixations to litter decreases, compared to the litter situation. More interaction effects between litter on the floor and graffiti were surprisingly not found in the second study. This may be due to the stronger effect of graffiti in attentional engagement. Graffiti grabs more attention and therefore leads passengers to look away from the litter. This can be caused by the knowledge of the passengers about the effort, time and money it costs to remove graffiti compared to the removal of litter on the floor. Therefore, passengers are more impressed by the presence of graffiti than by the presence of litter on the floor. It is clear that graffiti is a stronger environmental disorder when it comes to drawing attention, and graffiti affect the influence of litter on the floor on both attention engagement and cleanliness perception. Therefore, hypothesis 2 can be confirmed concerning the reinforcement of graffiti on litter on the floor.

The last two hypotheses were related to the current state of the passengers (i.e. waiting or walking behavior), which only measured in the second study.

Hypothesis 3: Walking passengers pay more attention engagement to the litter on the floor, than to graffiti. (Rejected)

The results of the second study showed that in the combined situation, walking passengers have more attentional engagement to graffiti, compared to the attention to graffiti in the situation with only graffiti. Which means that there is only an influence of the walking behavior on the attention engagement to graffiti, when there is litter on the floor. All the other situations seem not to be significant different from each other when passengers are walking. So, litter on the floor is needed to get attention of walking passengers to unclean environmental disorders, but the attention is longer payed to the graffiti than to the litter on the floor. Therefore, hypothesis 3 is rejected, because there was more an longer attention

to graffiti than to the litter on the floor in the combined situation. Probable reason is the goal of these passengers. The task was to walk to the end and back again. The point of destination was a glass wall, provided with graffiti, while the litter was mostly at the edges and less in the actual walking route. Therefore, litter on the floor is likely to be less an obstacle in the walkability of the walking route than it should have been, according to the argumentation for this hypothesis. Moreover, the goal where the passengers were searching for concerned graffiti. Walking passengers have only a difference in attentional engagement to the two environmental disorders when both disorders are presented in the railway station. This indicates that they are not soon attracted to the environment, which suggests that hypothesis 4 could be assumed:

Hypothesis 4: Waiting passengers have more attention engagement (compared to walking passengers) to both types of environmental disorders. (Accepted)

Baddely (2007) [cited by Eghbal-Azar, & Widlok, 2013] claimed that seeing things while being involved in bodily action involves more parts of the brain compared to a position of rest. This means that more mental capacity is needed to observe the environment when passengers are walking. This expectation is reflected in the results of the second study. Passengers who received the assignment to wait, had a longer fixation to litter and graffiti, compared walking passengers. Which means that indeed: waiting passengers pay more attention (compared to walking passengers) to both types of environmental disorders. Although, it is remarkable that walking passengers think that they have seen more environmental disorders, compared to waiting passengers, while the eye-tracking records showed that they had a shorter fixation time. The possible explanation for this, the difference between the overt and covert attention and the goal that the passengers had. As mentioned before, walking involves more capacity of the brain than waiting, and the walking passengers had the assignment to a point of destination covered with graffiti. As the passengers had not seen the manipulated area before the experiment, they might have focused on searching for this point of destination when entering the manipulated area. Since the brain is sharpened because they are walking, it is presumable that all the environmental disorders have been observed in the covert attention. However, the goal was to search for the glass wall, so the eyes where focused on this destination point and the very close vicinity, keeping the eyes out of the overt attentions concerning the environmental disorders. The fixation count does not differ between waiting and walking passengers, but the duration of the fixations does. When the fixation was moderately deviated from the focus on the wall and the nearby disorders, the fixation went very fast.

Taken together, there is a difference between walking and waiting behavior on the attention engagement to unclean environmental disorders, whereby mainly waiting passengers have more attention to environmental disorders compared to walking passengers.

Limitations

In the ideal situation both studies would have been performed on the same train station with the same unclean environmental disorders and with similar group of passengers. Due to weather limitations of the Tobii Glasses 2, it was not possible to conduct the second study on Enschede Kennispark. In addition, the passengers in the first study consisted of NS panel members. The people that are subscribed to the panel did so voluntarily and are generally of a retired age. So, they are probably more involved with NS than the average travelers and the relative young passengers in the second study, which could mean they are more critical about railway station. However, these panel members represent a group that is important to the NS and is closely involved in this organization.

Other limitations mainly concern the second study. First, the measurement of the emotions. Normally, research in service environments to emotions made use of the PAD-emotions of Mehrabian and Russell. For this study, Cronbach's alphas were only sufficient (with almost all the items) for pleasure. Moreover, many respondents indicated not to understand how to fill in the PAD-emotion construct. This is probably the reason why the constructs were not reliable and why no effect of the environmental disorders on the emotions was found. More research is necessary to evaluate the influence of these environmental disorders on emotion, with more information for the respondents in the questionnaire about how to fill out the PAD-emotion constructs. Second, the placements of these disorders. As mentioned before, some graffiti was placed on the glass wall. The glass wall became the point of destination for walking passengers. This was caused, because the assignment 'go left and walk along the lockers' was difficult to understand. To ultimately ensure that the passengers remained in the manipulated area, the goal was added to walk to the glass wall. However, this had probably made that passengers fixated to the glass wall, and with that also on the graffiti located on it. A lot of activity was happening behind the glass wall (e.g., bus stations, bicycle parking, many walking people), which made it hard to determine if someone looked at the graffiti, or through the glass to the people below. This also results in the clean condition in high scores concerning attention to graffiti. Third limitation of the second study concern the location of the litter on the floor. The litter on the floor was too much spread in the edges. More litter in the walking route of the participants would have allowed us to better use the literature. Fourth limitation concern the difference between passengers. Waiting and walking seems not to be the perfect distinction between passengers in a railway station. Passengers in a railway station are most of the time in both states. Therefore, for the next study can be recommended to make a distinction between passengers with the so-called lust and must designations (i.e. traveling for fun or traveling for work). The last limitation about the second study concerned the eye-tracking glasses. Since the glasses measure every move in the overt attention of the passengers, the data set was of high kurtosis and skewness. Therefore, it was necessary to perform a transformation on the data, so that the situations could be compared based on relative values. It results in lack of knowledge about the amount and duration of fixations. Nevertheless, the eye-tracker is an ideal is an ideal instrument for measuring human viewing behavior. It measures all conscious and unconscious eye movements. Producing objective unbiased data.

6.2 General conclusion

Looking back at the question that led to this study, some answers can be formulated to what the influence is of several types of environmental disorders (litter on the floor and graffiti) present at the railway station on the passengers' attention engagement, cleanliness perception and overall station evaluation. Litter on the floor and graffiti can be seen as environmental disorders of railway station environments and had a negative influence of the cleanliness perception of passengers. The eye-tracking part of the second study indicated that passengers looked more often and longer to graffiti, compared to litter on the floor. Wherein litter on the floor had a stronger influence on the cleanliness perception, and graffiti on the perceived pleasure. Moreover, a one-tailed interaction effect between litter on the floor and graffiti showed that graffiti affect the cleanliness evaluation of litter negatively. Graffiti pulled away the attention to litter, in the combined situation. The current state of the passengers (i.e. waiting or walking) is proven to affect attentional engagement to environmental disorders, wherein waiting passengers have more attentional engagement to environmental disorders than walking passengers.

6.3 Recommendations for future research

The influence of several types of uncleanliness on attention engagement, cleanliness perception, and environment experience had not been explored much, which results in a lot of possibilities for future research based on this study. The only previous study into several types of litter was performed in natural coastline environments. Whyles et al. (2016) found a negative effect of litter types on the evaluation of the environment. Cleanliness in a railway station is a major attention point of the NS. This study is therefore a good start to test the influence of, and attention engagement to several kinds of uncleanliness. However, it would be interesting to explore whether the impact is similar in other public areas, such as the inside and outside of trains, other similar public places like metro stations, metro's, bus stations and busses.

This study investigated the influence of several unclean environmental disorders on attentional engagement and cleanliness/environment perceptions. The next step would be to investigate which types of graffiti would have the most influence on attentional engagement and the cleanliness/environment evaluation. Graffiti are individual (or crew) tags, with the main aim to be recognized and they occur in many sizes, colors, words or pictures (Thompson et al., 2012). Any shape can have a different influence. It is therefore interesting to test different types of graffiti.

This study has proved that it is hard to find the underlying associations of environmental disorders. Nevertheless, the suggested associations of violating social norms (Keizer et al., 2008), crime and vandalism (Smith, & Cornish, 2006) of unclean environmental disorders, made it interesting to explore what unclean environmental disorders do with passengers. Therefore, it is interesting to perform the same study, but then for other dependent variables, like safety, fear and comfort.

The last recommendation hails more directly from this study, concerning the difference in current state. It is hard to distinguish walking and waiting behavior in a railway station. Both passengers are present in a railway station and both behaviors are carried out by the passengers. To get more insight in the actual effects of several unclean disorders on attention engagement and cleanliness/environment

perception, passengers could better be divided into must and lust passengers. Whereby people who regularly and systematically travel by train, such as commuters, are defined as must passengers, and people who are on an incidental journey, tend to be in a more recreational paratelic state are defined as lust passengers (Van Hagen et al., 2014).

6.4 Practical recommendations for NS

The recommendations for NS will be stated shortly below:

- Campaign against littering behavior “Do you waste your trash? Contribute to the cleaning of your own stay at the railway station, to make passengers more aware that clean train stations are partly in control of themselves.
- A visible place where it is allowed to spray graffiti. Graffiti painters want to be recognized and paint their tag over and over again if it is removed or covered. Thomson et al. (2012), claimed that the rapid removal of graffiti is extremely frustrating for writers. The graffiti makers may then simply try it again or move to a different area.
- More research on the influence of graffiti, as it takes a lot of time and money to remove graffiti. For example, what is the influence of graffiti on the travel experience of passengers and where has graffiti the most impact (e.g. on the platform or in/on trains).
- More research with the eye-tracking glasses, since the glasses carefully list the points of interest on a station while traveling

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Appendix A: Study 1 stimuli

(Based on the New York cleanliness scorecard (van Ryzin et al., 2008))

	 Clean station.	 Litter & graffiti are concentrated, large gaps between piles of disorders.
Clean, except for a few traces of disorder	 Litter on the floor	 Graffiti
Litter in concentrated spots, large gaps between piles of disorders.	 Litter on the floor	 Graffiti
Highly concentrated disorders, no gaps in the piles of disorders.	 Litter on the floor	 Graffiti

Appendix B: Questionnaire Study 1

Dutch, and used version:

Hartelijk welkom,

Voor mijn afstudeeropdracht ben ik benieuwd naar uw stations beleving. Daarom zal ik u nu eerst een foto laten zien en daarna enkele stellingen voorleggen. Dit duurt slechts enkele minuten.

Bij voorbaat hartelijk dank voor uw medewerking!

Janique Siepel

Student Universiteit Twente

Klik nu op de onderstaande pijl om door te gaan naar het onderzoek. Bedankt voor je deelname aan mijn afstudeeronderzoek!

Nadat u de afbeelding heeft bekeken, klikt u naar de volgende pagina.

1. In welke mate bent u het eens met de volgende stellingen?
(Kies één antwoord)

	Totaal oneens	Oneens	Neutraal	Eens	Totaal eens
Ik vind dit station aantrekkelijk	0	0	0	0	0
Ik ben bereid om op dit station te verblijven	0	0	0	0	0

2. U bent op dit station, hoe voelt u zich?
(Kies één antwoord)

	Totaal oneens	Oneens	Neutraal	Eens	Totaal eens
Rustig	0	0	0	0	0
Op mijn gemak	0	0	0	0	0
Angstig*	0	0	0	0	0
Onzeker*	0	0	0	0	0
Veilig	0	0	0	0	0
Welkom	0	0	0	0	0

3. Wat vindt u van de uitstraling van dit station? Dit station lijkt:
(Kies één antwoord)

	Totaal oneens	Oneens	Neutraal	Eens	Totaal eens
Rommelig*	0	0	0	0	0
Vies*	0	0	0	0	0
Netjes	0	0	0	0	0
Goed onderhouden	0	0	0	0	0
Schoon	0	0	0	0	0

4. Wat zijn uw associaties over het gedrag van mede reizigers op dit station?

Armoedig	0	0	0	0	0	Welgesteld
Gewelddadig	0	0	0	0	0	Geweldloos
Agressief	0	0	0	0	0	Vredelievend
Onbetrouwbaar	0	0	0	0	0	Betrouwbaar
Niet creatief	0	0	0	0	0	Creatief
Criminaliteit	0	0	0	0	0	Geen criminaliteit
Lage sociale status	0	0	0	0	0	Hoge sociale status
Lui	0	0	0	0	0	Actief
Immoreel	0	0	0	0	0	Moreel
Vandalisme	0	0	0	0	0	Sociaal wenselijk gedrag

5. Weet u welk station dit is?
Nee
Ja, namelijk……

6. Hoe vaak reist u via dit station? (Indien bij 5 “ja”, kies één antwoord)
4 dagen per week of vaker
1-3 dagen per week
1-3 dagen per maand
6-11 dagen per jaar
1-5 dagen per jaar

7. Wat is het eerste wat u opvalt als u kijkt naar de foto van dit station?

8. Wat zou u als eerste veranderen op dit station?

Appendix C: Assignment Study 2

The following assignment was given to the particpants during the main experiment. The passengers in the experiment were (inter)national passengers, therefore the assignment as well as the questionaire were in English and in Dutch as well. One of these two boxes was given to the passengers:

Waiting passangers:

Welcome,
Thank you very much for participating in this station experience research of the NS. First you will receive the mobile eye-tracker, that films the environment. As soon as you enter the platform, the investigation begins.

Assignment:
On the platform you are waiting for the next train to Hengelo. When entering the platform, **turn left to stay on the marked tiles** until the train arrives. Continue on behaving as usual on a station.
Have a nice stay!

Walking passengers:

Welcome,
Thank you very much for participating in this station experience research of the NS. First you will receive the mobile eye-tracker, that films the environment. As soon as you enter the platform, the investigation begins.

Assignment:
At the platform you **turn left, until the end of the platform and then you walk back to where you entered the platform.** Repeat this process until the next train arrives. Continue on behaving as usual on a station.
Have a nice stay!

You will **not** be filmed yourself. The investigation is anonymous and the images are treated confidentially. You are entitled to terminate this investigation at any time by informing the investigator.

I hereby declare that I voluntarily participate in this investigation and complete everything in truth.

Date: Passenger number:
Signature researcher: Signature passenger:

Appendix D: Questionnaire Study 2

You were just on the platform. As a result of your stay, we ask you to fill in this questionnaire. All questions in the questionnaire relate to your stay on this platform. Choose **one answer** for each question or statement. Your answers are anonymous and are treated confidentially.

Thank you in advance for completing!

---

1. What was the first thing you noticed when you entered the platform?

2. Indicate which feeling was most the appropriate to you.

During my stay on the platform, I felt…

Unhappy	0	0	0	0	0	Happy
Satisfied	0	0	0	0	0	Dissatisfied
Met	0	0	0	0	0	Not met
Strained	0	0	0	0	0	Relaxed
Hopeful	0	0	0	0	0	Despair
Bored	0	0	0	0	0	Entertained

During my stay on the platform, I felt…

Annoyed	0	0	0	0	0	Comfortable
Exited	0	0	0	0	0	Calm
Reared	0	0	0	0	0	Listless
Stimulated	0	0	0	0	0	Bored
Sleepy	0	0	0	0	0	Energetic
Alert	0	0	0	0	0	Slow

During my stay on the platform, I felt…

Guided	0	0	0	0	0	Independent
Impressionable	0	0	0	0	0	Influential
Leading	0	0	0	0	0	Compassionate
Steering	0	0	0	0	0	Following
Weighty	0	0	0	0	0	Unimportant
Dominant	0	0	0	0	0	Submissive

3. To what extent do you agree with the following statements about the appearance of this station.

This station seems:

	Totally disagree	Disagree	Neutral	Agree	Totally agree
Messy	0	0	0	0	0
Dirty	0	0	0	0	0
Neat	0	0	0	0	0
Well maintained	0	0	0	0	0
Clean	0	0	0	0	0
To meet my wishes	0	0	0	0	0

4. At this station, there are expressions which I associate with:

	Totally disagree	Disagree	Neutral	Agree	Totally agree
Violence	0	0	0	0	0
Aggression	0	0	0	0	0
Unreliability	0	0	0	0	0
Creativity	0	0	0	0	0
Morally desirable	0	0	0	0	0
Active	0	0	0	0	0
Criminality	0	0	0	0	0
Socially desirable behavior	0	0	0	0	0
Poverty	0	0	0	0	0
High social status	0	0	0	0	0

5. To what extent do you agree with the following statements:

	Totally disagree	Disagree	Neutral	Agree	Totally agree
I try to avoid situations where someone else tells me what to do.	0	0	0	0	0
I would prefer to be a leader rather than a follower.	0	0	0	0	0
I enjoy making my own decisions.	0	0	0	0	0
I prefer to avoid situations where someone else has to tell me what it is I should be doing.	0	0	0	0	0

6. To what extent have you seen the following objects on the platform?

	Not at all	To a small extent	To a medium extent	A lot	Very much
Newspaper	0	0	0	0	0
Candy bag	0	0	0	0	0
Graffiti	0	0	0	0	0
Train ticket	0	0	0	0	0
Cigarette butt	0	0	0	0	0
Weed	0	0	0	0	0
(Soda) Can	0	0	0	0	0
Empty bottle	0	0	0	0	0

7. How often do you travel from this station? (Choose one answer)
4 days per week or more
1-3 days per week
1-3 days per month
6-11 days per year
1-5 days per year

8. What is your gender?
Man
Woman

9. What is your age?
…….year

10. Do you have any comments about this investigation?

Thank you for your participation