THE CREATION OF DESIGN PRINCIPLES FOR WAYFINDING IN A FESTIVALSCAPE:
A SYSTEMATIC VIEW ON FACTORS INFLUENCING WAYFINDING.

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Research Paper

THE CREATION OF DESIGN PRINCIPLES FOR WAYFINDING IN A FESTIVALSCAPE:

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Design is in everything we make, but it's also between those things. It's a mix of craft, science, storytelling, propaganda, and philosophy

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ABSTRACT

Aim | This research aims to add theoretical (systematic literature review) and practical knowledge (design principles) of wayfinding in a festival environment to the literature stream and encourage additional research.

Methodology | A systematic literature review was used to obtain salient articles. The systematic literature review identified 11.200 articles, however, after an article selection based on certain criteria, 26 articles remained and were reviewed.

Results/structure | The research consists out of four stages, stage one is used to for identifying relevant concepts (i.e. wayfinding & festivalscape) and variables (i.e. environmental cues, human factors, motivational strategies), stage two used the obtained information from stage one for the input for the systematic literature review (n=26) during this stage the articles will be selected and analysed. The third stage is for reporting the finding of the analyse. based on the analyse, environmental cues (signage, landmarks, maps, colour and lighting), human factors (gender, language, culture), strategies (route & survey) and deeper insights (familiarity & complexity) have been found to have the ability to influence wayfinding. The fourth and final stage is used to apply the obtained knowledge for creating the design principles.

Practical implications | Based on the knowledge gained from the systematic literature review, the design principles were created to guide the communication specialist in wayfinding to design and evaluate existing wayfinding design.

Conclusion | The results of this research add literature to a field where literature is limited and adds a comprehensive systematic literature review of wayfinding factors in different environments.

Keywords: Wayfinding, Festival, Design principles, Systematic literature review.

INTRODUCTION

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Imagine a place where music, lights, food, and drinks come together and where people distract themselves from daily life. It is an environment where dancing, drinking, eating and socialising is encouraged. This entertaining environment can be best described as a festival. It is evident by the numbers that festivals are popular. In 2018 alone, the Netherlands hosted around 836 festivals, which approximately attracted 18,2 million people ("Festival overzicht," 2018). The idea of a festival is to create an environment where patrons can fully experience the ambience. The experience of the festival environment has been found to be an important part of the festival as most patrons seek displacement from reality (Lee, Lee, Lee & Babin, 2008). Creating a complex environment such as a festival can bring multiple complications, one of these complications can be wayfinding. Wayfinding can be described as a process of interpreting the environment through, environmental cues, whilst navigating to a desired destination (Algase, Son, Beel-Bates, Song, Yao, Beattie & Leitsch, 2007; Al-Homoud, 2003; Chown,1995; Downs & Stea, 1973; Farr, Kleinschmidt, Yarlagadda & Mengerern, 2012; Lynch, 1960; Montello & Raubal, 2012). If wayfinding is not properly guided, it can lead to stress, frustration and blockage of paths. Nonetheless, these negative reactions can be negated with a proper wayfinding system. A wayfinding

system can be described as a system that helps people recognise their location and guide them toward their goal, it can further strengthen peoples believe that they are traveling in the right direction (Farr et al., 2012). Therefore one of the goals of this research is to guide communication specialist in wayfinding to create such a wayfinding system. In order to guide the communication specialist in wayfinding, multiple design guidelines will be formulated after performing a four-stage research.

The first stage of this research will focus on the obtainment of information. First, the crucial concepts will be explored in the form of wayfinding and festival environments and second the research is used to identify variables that influence wayfinding. The identified variables are in the form of environmental cues (e.g. signage & landmarks), human factors (e.g. gender & language) and motivational strategies. The first stage will be about gaining knowledge about the important concepts and basic knowledge about the variables that can influence wayfinding.

The second stage will continue with the obtained information from the previous stage as this will be the input for the systematic literature review. The second stage is all about the development of the method for the systematic literature review and the purification and analysing of the salient articles.

The third stage is the reporting of the analysed results from the second stage. The third stage will be about gaining a deeper understanding of how the variables work.

The fourth stage will be about analysing and evaluating the results for the creation of the design principles. During this stage, the design principles will be developed and proposed.

The fourth stage is all about the formulation of the design principles.

It might be worth noting that the complexity of a festival environment in combination with wayfinding has had little attention in the literature. This research will try to fill this gap while bridging the disparity between theoretical and practical science. The design principles may help communication specialists in wayfinding evaluate existing systems and guide a new design process. In general, design principles to manage wayfinding are seen as a way to improve wayfinding (Bonfanti, Vigolo, Douglas & Baccarani, 2017; Farr et al., 2012). Therefore, this research will focus on creating design principles for an untapped environment.

In order to, develop the design principles the following research question was created to get insight into the different variables.

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How do environmental cues, human factors and motivational strategies influence wayfinding and how can it be applied to create design principles for wayfinding at festivalscapes?

STAGE ONE | BACKGROUND

The first of the four stages is used to obtain information from articles about the relevant concepts, wayfinding and festival environment. Further, this stage is used to obtain information about variables that might influence wayfinding. The reporting of this stage consists of two parts. First, the concept and context of wayfinding and festivalscapes will be defined and second, the variables of wayfinding will be discussed and identified. The identified variables will be further explored in the second stage.

2.1 | Wayfinding

To understand the way people find their way in an environment, academics came up with the concept of wayfinding. Over a span of sixty years wayfinding has been defined and developed in multiple different disciplines. To illustrate the growth and development of wayfinding a brief history of wayfinding will be given. The first conceptualisation of wayfinding originates from architecture in the 1960s, Lynch (1960) conceptualised that people use sensory cues from the environment to navigate through the environment. Following Lynch, Passini (1981) conceptualised wayfinding as a spatial orientation process that encompasses three stages: information processing, decision-making and decision execution. Downs and Stea (1973) who published their conceptualisation in the discipline of geography argue that the wayfinding process consists out of four stages: orientation, route selection, route control and recognition. Another conceptualisation from geography came from Montello and Raubal (2012). They argue that wayfinding consists of three steps: route creation and choosing, establish and maintain orientation and recognising the environment.

Concepts derived from a psychology perspective are as follows wayfinding consist of four tasks: identification, directional selection, course selection and environment processing (Chown, 1995) and the people use a cognitive process that processes the physical environment whilst using previous experiences (Algase et al., 2007). Furthermore, social sciences suggest that wayfinding is a process of finding the target area in familiar or unfamiliar environments using environmental cues (Farr et al., 2012). The definitions of wayfinding differ throughout the disciples, ergo there is not one commonly used definition for wayfinding in general.

However, some common features arise: (1) encountering the environment, (2) processing of the environment and (3) executing an action. In other words, wayfinding can be defined as the process of interpreting the environment through environmental cues, whilst navigating to the desired destination. Thus, to investigate how effective wayfinding can be established is to investigate the environmental cues that impact the wayfinding ability. However, also the environment is seen as an essential factor that can influence how people perceive environmental cues, therefore, the next paragraph will focus on the environment.

2.2 | Environment (Festivalscape)

Assuming that the environment plays an important part in wayfinding. It is therefore fundamental to understand the specific environment and in this situation, it is the festival environment. A festival can be described as a complicated and dynamic environment and can entail an array of different themes i.e. music, food, wine, sports and cultural (Jaeger and Mykletun, 2009; Lee et al., 2008; Mason and Paggiaro, 2012). Due to the wide variety of festivals, a general definition of the festival characteristics is a complex issue (Jaeger & Mykletun, 2009). Despite the complexity Jaeger

and Mykletun (2009) suggested the following definition of a festival:

> 'a public, themed celebration with a formal program. It has a core activity and additional activities. The festival has a timescale, which accomplishes both the core activity and the additional activities'
>
> *(Jaeger & Mykletun, 2009, p.332)*

To narrow the context of a festival, the created design principles will mainly focus on medium or major sized outdoor electronic dance music (EDM) festivals that encompass multiple music stages, food areas, at least < 10.000, 18+ visitors and is one or more days.

The definition of Jaeger and Mykletun fails to mention a vital part of a festival, the environment (Lee et al., 2008; Mason et al., 2012). Already mentioned before is that the environment is an important part of wayfinding.

Lee et al (2008) proposes the term festivalscape to explain the environment. The festivalscape is described as a physical environment, intertwining tangible elements and the event atmospherics (Mason et al., 2012). Likewise, Lee et al. (2008) propose that the festivalscape is a place where the visitors experience the atmospherics. Lee et al. (2008) borrow the literature of service environments, especially the servicescape, to define the festivalscape.

Since some elements of a festivalscape are perceived holistically, it is, therefore, important to research the dimensions. Since there is a gap in the literature of wayfinding on a festival, it is important to understand the difference in these environments.

2.3| Environmental Cues

The environment consists of different environmental cues and the literature suggests that these cues influence the holistic experience, and hereby influencing the approach-avoidance behaviour (Mehrabian and Russell, 1974). In order to, understand how environmental cues can influence wayfinding, a review of the literature is needed.

The initiate literature search produced the following environmental cues that play a part in wayfinding. The literature shows that signage (O'Neill, 1991), landmarks (May, Ross, Bayer, and Tarkiainen, 2003; O.'Neill, 1991; Lynch, 1960), colours (Hidayetoglu, Yildirim, and Akalin, 2012), lighting (Dalke, Little, Niemann, Camgoz, Steadman, Hill & Scott, 2006) and a combination of colours and landmarks (Hawes, Brunyé, Mahoney & Sullivan, 2012) all influence wayfinding on a different level.

Hence, the literature shows that different environmental cues affect wayfinding. However, further investigation of these environmental are necessary to determine the eligibility of these effect in a festival environment. Besides, the environmental cues are often described and researched as individual elements, even though elements can interact with each other and can enhance wayfinding as a collective.

2.4 | Human Factors

Adjoining to the environment and environmental cues, human factors are also found to influence wayfinding.

The literature shows that gender difference between men (Chai & Jacobs, 2009; Lawton, 1996) and woman (Barkely & Gabrial, 2007) can influence the wayfinding performance. Furthermore, the literature shows that language, culture (Lawton & Kallai, 2002) and biological factors (i.e. testosterone) (Jonasson, 2005; Lawton, 2009) can influence wayfinding.

Thus, the literature shows that the different human factors can influence wayfinding abilities of people. However, to really understand the importance of these variables, more research is needed to determine the importance of these factors in the festival environment.

2.5 | Motivational Strategies

People tend to choose different strategies to reach their destination. The literature identified some of these strategies and titled these strategies as motivational strategies. For instance, Fewings (2001) identified three approaches, recreational, resolute and emergency. Recreation can be described as the hedonic type, where an individual seeks wayfinding problems and enjoys the experience. Resolute can be described as the efficient type, where the individual seeks for the most efficient way of navigation to their desired location. And lastly the emergency type can be described as the conventional type, the individual needs to find the destination as convenient as possible typically under pressure.

Typically, the individual chooses his or own strategy depending on the situation. However, the chosen strategy can impact the way people perceive the environment. It is,

therefore, of importance to understand this process of choosing the strategy and what the strategy entails.

2.6 | Conclusion

The literature stated in stage one is impartial and needs further research to understand the applicability of the different variables in a festival environment. The variables now are reported as individual elements. However, an interaction between the factors is likely to occur. Further, the research findings are context-specific and therefore not easily generalisable to the festivalscape.

The second stage will give identify the articles that report the context of these concepts and variables. By means of a systematic literature review, these articles will be identified and analysed for patterns and interactions of the variable.

Eventually, the systematic literature review will be input for the third stage where the results will be reported.

In stage four the research question will be answered by creating the design principles.

STAGE TWO | METHOD

The first stage has been used to create a basic understanding of the concepts wayfinding, festivalscape, environmental cues, human factors and motivational strategies. The second stage will use the method of systematic literature review for further exploration of the obtained variables. This research will follow the guidelines of the PRISMA-P 2015 checklist (Moher, Shamseer, Clarke, Ghersi, Liberati, Petticrew, Shekelle & Stewart, 2015).

3.1 | Eligible criteria

The articles selected were salient to the main research question:

> *"How do environmental cues, human factors and motivational strategies influence wayfinding and how can it be applied to create design principles for wayfinding at festivalscapes?".*

Further, the articles needed to be published and peer-reviewed; therefore 'gray' literature like, books, conference papers, unpublished papers and working papers were excluded to ensure the quality and validity of the articles. Moreover, the articles needed to be published in the following categories: environmental sciences', 'geography', 'psychology' and 'social sciences', due to the origin and development of wayfinding. The articles selected did not

have a limitation on publication year or citations and impact factor.

More exclusions were needed to purify the salient articles. Articles that contained the following topics: people with disability's, evacuation, virtual reality, virtual environment, gaming environments, sound navigation, children and older people, animals and driving navigation were likewise excluded from the salient articles. These topics are not directly linked with the festival environment and the target group (Adults 18+).

3.2 | Databases

For the systematic literature review, three different databases (Scopus, Web of Science & PsychInfo) were used. These databases were chosen for their multitude of different disciplines except PsychInfo. This database focuses on psychology and social sciences related to the behaviour of individuals. The electronic searches were executed in May 2019.

An overview of the keywords is visible in Table 1. The main keywords were directly linked to the presented concepts and variables in stage one. The narrow keywords are different terms for the same concept and the broad keywords are terms related to the main concept.

Table 1. Keywords

Main concept	Narrow keywords	Broad keywords
Wayfinding	*wayfinding, pathfinding, spatial orientation, route selection, route strategies*	
Festivalscape	*festivalscape, servicescape, service environment*	*environment*
Motivational Strategies	*wayfinding strategy, route strategy*	*locomotion*
Human Factors	*language, gender, culture*	
Environmental Cues	*signs, signage, digital signage, nodes, landmarks, lighting, colours, maps, multisensory, smell*	

3.3 | Search strategy

As mentioned before the keywords **(Table 1)** were put in the three different databases (Scopus, Web of Science & PsychInfo). The following string was put in the different databases:

> *Wayfinding OR Pathfinding OR "Route selection" OR "Spatial Orientation"*
> *AND*
> *Festivalscape OR Servicescape OR "Service environment" OR Environment*
> *OR*
> *"Route strategy" OR "Wayfinding strategy" OR Locomotion*
> *OR*
> *Language OR Gender OR Culture*
> *OR*
> *"Environmental cues" OR sign* OR nodes OR landmarks OR multisensory OR Maps OR Smell OR Colours OR Lighting*
> *AND NOT*
> *Disability OR old* OR eld* OR child* OR "auditory navigation" OR "virtual environment" OR driv* OR blind OR Computer OR Animals OR Virtual OR Gam* OR Schizophrenia*

The keywords were accompanied by the limitations of the different disciplines 'environmental sciences', 'geography', 'psychology' and 'social sciences' and the limitation of the English language.

3.4 | Article selection

The selection of the articles was performed in multiple steps, the steps are visible in **Figure 1**. The initial search was in the databases Scopus, WebofScience and PsychINFO. This search resulted in n = 11.200 articles. Based on the filter options provided by the different databases articles could be excluded that did not meet the criteria. Articles written in other languages than English (n= 388), articles that were not peer-reviewed (n = 2.962), and articles published in a different discipline (n= 5.284) were excluded. The refinement of the articles reduced the number of articles to n = 2.566. After the refinement of language, peer-reviewed and discipline, the articles were evaluated on the titles.

The remaining articles of the previous step were refined on title, abstract, introduction and full text and deleted when it did not meet the inclusion criteria: (1) describe wayfinding in relation with an environment, people, strategies and environmental cues, (2) focus on environmental cues, motivational strategies and human factors, (3) conducted in a real environment for example hospitals, libraries, airport etc and (4) is relevant for a festival. The first refinement based on the title of the articles reduced the number of articles by n = 2442 articles. The title of the excluded articles did not meet the inclusion criteria established above (e.g. wrong context, wrong target group, animal experimentation, virtual wayfinding). When the refinement was completed the remaining articles were imported into Endnote. Based on the information in Endnote, duplicates could be removed from the list (n = 20). Reducing the number of relevant articles to n= 104, the remaining articles were assessed through reading the abstracts.

The abstracts were judged on the same inclusions criteria as for the title. The refinement after reading the abstract subtracted 51 articles. Resulting, in a total of n = 53 articles left for review. The next stage of the refinement was reading through the introductions.

The introduction of the 53 articles was judged with the same criteria as the title and abstract and an additional 14 articles were excluded. The next stage of the refinement was reading through the full text.

The full texts of 39 articles were read and judged with the same criteria as before and additionally evaluated on quality. All the articles were evaluated by the following criteria: (1) is the aim of the article clear, (2) is the method appropriate and valid for the research question, (3) is the risk of bias assessed, (4) are the results transparent and clearly reported and (5) are the conclusion supported by the findings or other literature. If the article missed multiple criteria it was excluded. The reading of the full text of the 39 articles leads to an additional of 13 articles that were excluded.

The remaining articles (n = 26) were assigned to four categories portraying the overall themes of the articles. The four categories are (1) environmental cues, (2) human factors, (3) strategies and (4) deeper insights. These categories were used to find a common themes in the literature. The final stage of the systematic literature review was again reading the full texts.

Records identified through databases
(Scopus, Web of Science & PsychINFO)
n = 11.200

Excluded by language n = 388
Excluded by non article n = 2.962
Excluded based on discipline n = 5.284
Remaining n = 2.566

Excluded based on title n = 2.442
Excluded duplicated = 20
Remaining n = 104

Excluded based on:
| Wrong environment
| Laboratory research
| The use of GPS
| Wrong Method

Excluded based on abstract
n = 51
Remaining n = 53

Excluded based on introduction
n = 14
Remaining n = 39

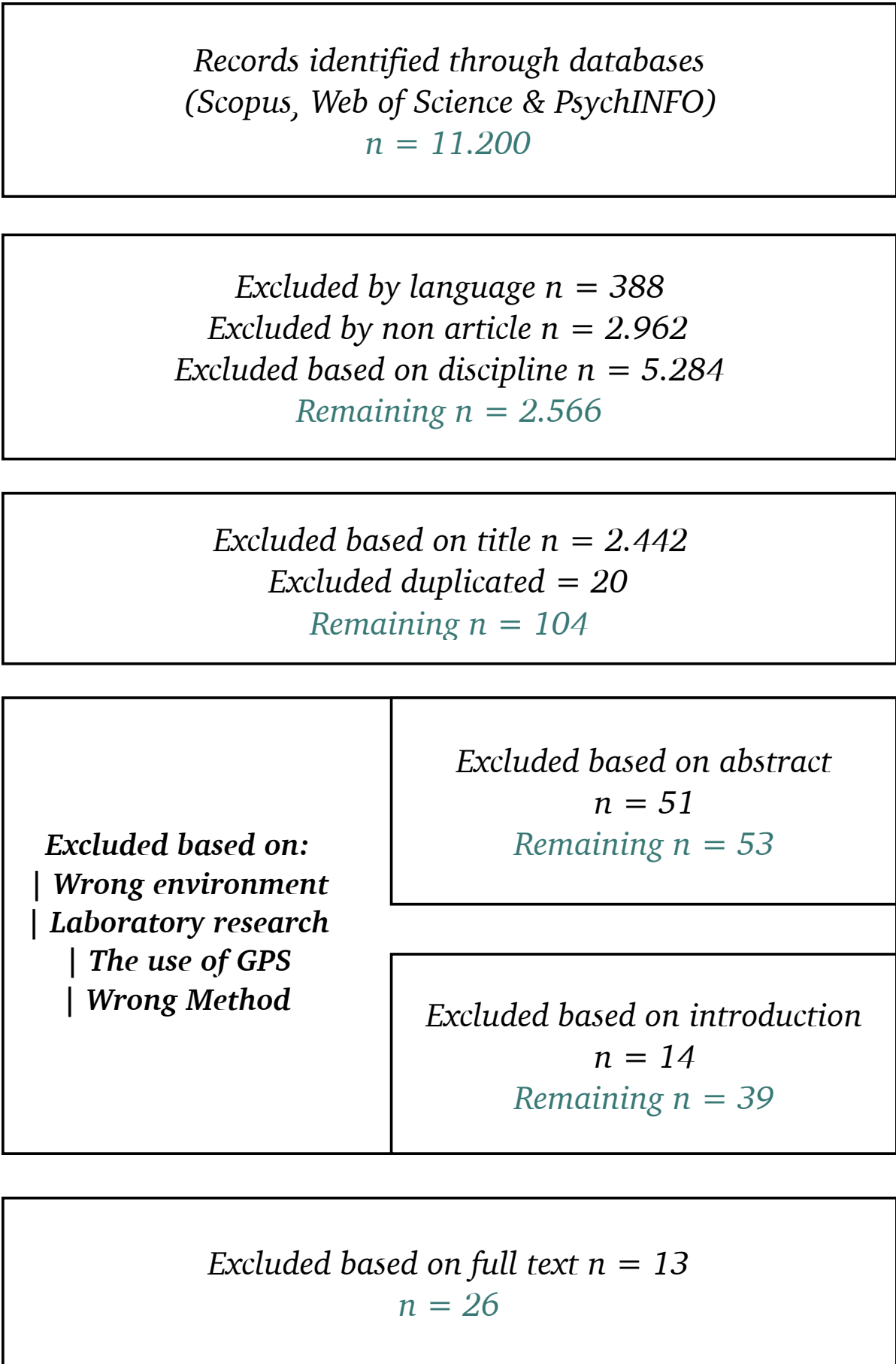Excluded based on full text n = 13
n = 26

Figure 1. Systematic literature review

3.4 | Analysing the articles

The final step of the systematic literature review was to read the full texts and analyse the content. The four categories (1) environmental cues, (2) human factors, (3) strategies and (4) deeper insights were used to structure the different factors influencing wayfinding. After the first reading of the full texts (n=36) several variables emerged. These variables were used for analysing the articles **(Table 2**).

Each article was then searched for statements that were associated with one of the variables. The statements could contain citations of other authors or their own results or arguments. Next, the statements were placed in a table associated with one appropriate to the variable. Following, all the tables were then further analysed and examined for similar statements about the variables. These statements were then grouped being the input for the results. As a result of these steps, a comprehensive overview of the variables was created. Due to the length of the statements a summarised version of the tables can be found in the **appendix tables**.

Table 2. Variables

Environmental Cues	*Signage, Landmarks, Maps, Colour & Lighting*
Human Factors	*Gender, Culture & Language*
Motivational Strategies	*Route strategies & Survey Strategies*
Deeper insights	*Complexity & Familiarity*

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Stage three continues by reporting the results of the systematic literature review. The results are obtained by reading the full text of the remaining articles (n=26) and by analysing the articles. Four categories similar to the categories in stage one and two is used for the structure. Namely, (1) environmental cues, (2) human factors, (3) strategies and (4) deeper insights. As previously mentioned and in order to accommodate a deeper understanding of the results, every independent variable has a table in the **appendix tables**. During the second stage, a similar structure of reporting is used. For instance, the results of environmental cues are structured as positive effects, negative effects and recommendations. Human factors, motivational strategies and deeper insights are discussed by the means of the effects. The reporting of the variables all start with the variable with the most arguments in the analysed literature. Further, at the end of every category, a conclusion is presented. Just for clarification, people who navigate through the environment are addressed as wayfinder(s).

4.0 | Environments

Only one article has researched the festival environment, all the other articles discussed different environments. The articles discuss the following environments: cities (n=3), universities (n=3), hospitals (n=3) and laboratories (n=3), further environment are shopping malls (n=2), libraries (n=2), forests (n=2) and basements(n=2). Furthermore, five articles did not discuss any specific environment and were mainly focussed on a descriptive method not tied to an environment.

4.1 | Environmental cues

In most articles, the influence of the environmental cues on wayfinding is discussed (n=21). Most of the articles state one or more environmental cue, therefore multiple articles can be mentioned more than ones in the results. The environmental cues can be categorised as follows: signs (n=21), landmarks (n=16), maps (n=16), colour (n=6) or lighting (n=4).

Signage

The majority of the articles discuss the influence of signs on wayfinding.

| Positive effects

In twenty-one articles, eight different positive effects of signs have been identified.

Directional signs| The most discussed positive effect is the effectiveness of directing wayfinders with signs (Butler et al., 1993; Li et al., 2012; Lorenz et al., 2013; Miller et al., 2000; Soh et al., 2004; Xia et al., 2008). The study of Li et al. (2012) found that the walked route in a library is influenced by the signs present and Miller et al. (2000) found that

directional signs are a key part of wayfinding and are heavily relied upon when wayfinding.

Simplify the environment | Another positive effect of signs is that it simplifies the environment (Butler et al., 1993; Cope et al., 1999; Lorenz., 2013; O'Neill, 1991). Butler (1993) found that signs simplified the wayfinding task in the basement of a university.

Reduce anxiety | Another effect of signage is the reduction of anxiety (Chang, 2015; Filingeri et al., 2017; O'Neill, 1999). Chang (2015) found that signage helps a tourist reduce anxiety by reducing the feeling of being lost.

Help locate | Signage can also be used by wayfinders to locate themselves in the environment (Chang, 2015; Fuller, 2002). In relation to an airport environment, Fuller (2002) argues that signage reconfigures the architectural and geophysical space into recognisable territories, therefore helping wayfinder to locate themselves.

Increase rate of travel | Another positive effect of signage is the increase in the rate of travel (Cope et al., 1999; O'Neill, 1999). O'Neill (1999) found that the presence of signage in a university increased the rate of travel of wayfinders.

Familiar awareness | Signs also have the ability to give an unfamiliar environment a familiar awareness (Chebat et al., 2005; Fuller, 2002).

Reduce backtracking | Further signage has been found to reduce backtracking behaviour of wayfinders (O'Neill, 1999)

Experience the environment | When signage is used efficiently it can help the wayfinder experience the whole environment. (Chang, 2015; Tam, 2011; Xia et al., 2008). Xia et al., (2008), observed wayfinders in a national park and found that when the wayfinders are somewhat familiar with the environment, that the group was more goal-oriented and more conscious of the environment.

| Negative effects

Signage is not always as effective as previously defined, signage in the wrong context has the ability to negatively influence the wayfinder. The twenty-one articles discuss five different negative effects or moderating effects on wayfinding.

Not noticed/inadequate | The most discussed effect is that signage is more often not noticed or inadequate (Chebat et al., 2005; Fendley, 2009; Filingeri et al., 2017; Peponis et al., 1990; Soh et al., 2004). For instance, in the study of Soh et al. (2004) participants of a field experiment in a forest missed several signs due to the low saliency (i.e. signs that were created to blend into the forest) of the design.

Complex | Furthermore, some articles discuss the negative impact on wayfinders of complex environment in combination with signage (Baskaya et al., 2004; Butler., et al 1993; Cope et al., 1999; Dogu et al., 2000; Lorenz et al., 2013; O'Neill, 1999). Dogu et al, (2000), argues that some parts of a complex shopping mall are difficult to identify and too complex when too much signs are used and therefore causing wayfinding problems.

Architecture | When architecture and signs are designed separately the signage will likely not help wayfinders (Baskaya et al., 2004; Dogu et al., 2000; Peponis et al., 1990; Soh et al., 2004). Peponis et al., (1990), argues that architecture in a hospital should be complemented by the signage and not designed as an independent element.

Crowd congestion | When signage is difficult to read it can lead to crown congestion (Filingeri et al, 2017).

| Recommendations

Articles also provide recommendations for the use of signage in an environment. Eleven articles discuss seven different recommendations for the usage of signage.

Graphic signage | The use of graphic signage (e.g. universal icons) can cool down anxiety in an unfamiliar environment by switching the anxiety to a more familiar feeling (i.e. recognisable signage that is also used in other environments). (Chang, 2015; Dogu et al., 2000; Fuller, 2002; O'Neill, 1991).

Decision points | The use of signage at decision points can reduce the time wayfinders take to find their destination (Baskaya et al., 2004; Li et al., 2014; O'Neill, 1991; Waller, 2007).

Sightlines | Using signage within the sightlines of the wayfinder can improve legibility and observability (Filingeri et al., 2017; Fuller, 2002).

Wayfinding system | Further advice for signage is a wayfinding system, that is consistent and complete for a complex environment (Chang, 2015; Peponis et al., 1990).

Other | Other advise for signage are the use of cardinal directions on signage (Butler et al., 1993), using Euclidean distance on signage (Soh et al., 2004) and lastly the use of the right font (Waller, 2007).

Landmarks

Sixteen articles discuss and argue about the effect and selection of landmarks. The essence of a landmark can be described as follows.

> *"Effective landmarks are features which are noticeable, prominent, memorable, describable and something that is unusual within the environment. Landmarks help people to orientate themselves, and provide something for people to refer to when giving spoken directions."* **(Miller, p.142)**

| Positive effects

Orientation and identification | The first and foremost mentioned positive effect is that landmarks will help the wayfinder orientate and identify themselves in their current environment (Baskaya et al., 2004; Denis et al., 2014; Dogu et al., 2000; Fendley, 2009; Ishikawa et al., 2011; Lorenz et al., 2013; Miller et al., 2000; Mottet et al., 2006; Xia et al., 2008). Ishikawa et al. (2011), argues that locations can be identified through the use of landmarks and therefore be used as orientation elements.

Route decision and directional cue | When landmarks are placed at a route decision point it can give a directional cue to the wayfinder and improve wayfinding. (Chang, 2015; Denis et al., 2014; Hund et al., 2014; Padgitt et al., 2014; Soh et al., 2004; Xia et al., 2008). Observations at junctions in a forest found that landmarks made it easier and faster to navigate (Padgitt et al., 2014). Other observations in a national park showed that the landmarks were mainly used to facilitate directional change (Xia et al., 2008).

Unfamiliar | Landmarks can also act as an element where wayfinders can rely on (Baskaya et al., 2004; Xia et al., 2008). According to Baskaya et al. (2004), landmarks are

used when the cognitive maps of wayfinders are incomplete. In other words, when the wayfinder cannot form a visual picture of the environment.

Reduce memory usage | Additionally, landmarks can assist wayfinders by freeing up memory by taking away their reasoning (Denis et al., 2014)

| Negative effects

Authors discuss fewer negative effects for landmarks (3) than for signage (11).

Distance judgement | Mottet et al. (2016) argued that an environment containing landmarks can influence the judgement of the distance by wayfinders.

Incorrect usage | Xia et al. (2008) argues that when landmarks are positioned at the wrong location it could lead to wrong decisions by the wayfinders.

Environment | Fuller (2002) argues that airports are explored through signage and not through landmarks. Indicating that landmark might not work for every environment.

| Recommendations

Uniqueness | The landmarks should be a unique element in the environment, in consequence, the uniqueness should improve orientation, identification and memorability (Ishikawa et al., 2011, Lorenz et., 2013; Miller et al., 2000). By using unique landmark for instance in a symmetrical environment will enhance wayfinding (Baskaya et al., 2004)

Decision Point | The landmarks should be at decisions points and thereby helping the wayfinder from point to point (Denis et al., 2014; Ishikawa et al., 2011)

Route and Survey | Landmarks in combination with verbal descriptions, for instance, route (e.g., turn right at the ferris wheel) or survey (e.g., go north for the main stage) can help

wayfinders find their destination more straightforward (Hund et al., 2014; Lawton, 1996).

Maps

Sixteen articles discuss the effect that a map can have on wayfinding and additionally it discusses the creating of a map.

| Positive effects

Spatial orientation | Five articles discuss that a map can enhance spatial orientation and therefore help the wayfinder orientate themselves in the environment (Fendley, 2009; Hund et al., 2014; Ishikawa et al., 2011; Lorenz et al., 2013; Soh et al., 2004). Participants in an experiment rotated their map to align with the environment (i.e. forest) and thereby finding their orientation (Soh et al., 2004)

Relieve anxiety | Three articles discuss that a map can relieve anxiety. (Chang, 2015; Miller et al., 2000; Mottet et al., 2016). According to Miller et al. (2000) and Mottet et al., (2016), people felt more assured when they utilised a map.

Regions |Two articles discuss that dividing the map into regions can help the wayfinder process the map better (Bailenson et al., 1998; Fendley, 2009). Bailenson et al. (1998) established that when individuals process a map they were doing this region by region and not as a whole.

| Negative effects

You-are-here | The you-are-here maps are argued as ineffective and slow (Butler et al., 1993; Dogu et al., 2000; Lawton, 1996). The results of Butler et al. (1993) showed that participants with the you-are-here map in a university were slower than the participants with no-aids.

More memory | Detailed maps are difficult to comprehend and when misalignment occurs it can cause that the wayfinder uses more memory (Li et al., 2014).

No Spatial awareness | Maps can lead to poor spatial awareness and causing poor spatial knowledge about the environment (Chang, 2015).

Layers | Multiple layered maps can be difficult to understand and lead to poor wayfinding performance. (Fuller, 2002)

| Recommendation

Regions | Using regions on a map would decrease the information by dividing it into smaller blocks and making it easier to comprehend (Bailenson et al., 2004; Fendley, 2009).

Landmark | When the landmarks are placed adequately on the map and the landmarks are easy to align with the environment then the spatial orientation will be improved (Lorenz et al., 2013).

Colour

The effects of colour on wayfinding are less discussed in the literature. Only four articles discuss the positive effects, four articles discuss the negative effects and three articles gave recommendations on how to use colour.

| Positive effects

Distinguish Locations | Three articles discuss the ability to use colour to distinguish locations in an environment (e.g. shopping mall, forest, city) (Baskaya et al., 2004; Ishikawa et al., 2011; Li et al., 2014). According to Ishikawa et al. (2014), colours are salient (i.e. bright colours) when choosing landmarks in an environment (i.e. city) and hereby distinguishing the different locations.

Attract attention | Appropriate colours can also enhance the comprehension of an object, by the means of attracting the eye (Dogu et al., 2000)

| Negative effects

Colours have also been found to have a negative effect on wayfinding. Three different articles discuss the negative effects of the use of colours.

Create disorientation | First of all, two articles discuss the effect of excessive use of colours and that it can create disorientation (Dogu et al., 2000, Fendley, 2009). Supported by the myriad of different colours in London the display of information created confusion and inconsistency for the wayfinder (Fendley, 2009)

Not legible | Secondly, two articles discuss the effect of low colour contrast on the legibility of the object (Miller et al., 2000; Waller, 2007). Colours in combination with a text and low colour contrast (e.g. yellow with white text) can impact the legibility of the text (Waller, 2007).

Fatigue eyes | Lastly, the use of bright colours can also fatigue the eyes (Dogu et al., 2000).

| Recommendations

Three articles recommend the appropriate use of colour.

High saliency | High salient colours (e.g. bright colours) can improve the legibility of the object (Soh et al., 2004; Waller, 2007).

Colour coding | Using colour coding can help to specify different locations (Li et al., 2014). Yet, Miller et al., (2000) found that only a quarter of the people in a different environment (hospital) notices the colour coding, which suggests that colours coding could be of finite use.

Lighting

The effect of lighting is not often discussed in the articles, only five articles discuss the effect of lighting on wayfinding. The articles stated one positive effect, one negative and only one recommendation

| Positive effects

One article stated a positive effect on the use of lighting.

Illumination| Appropriate lighting can help illuminate and make the element more prominent and thereby enhancing the overview (Miller et al., 2000).

| Negative effects

Further, only one article discusses the negative effect of lighting.

Readability | Lighting that shines too bright can cause a problem with readability (Miller et al., 2000)

| Recommendation

Two of the articles gave a recommendation for the use of lighting.

Natural Light | Optimum use of sunlight can cause directional change and also make wayfinders more confident in an unfamiliar environment (Baskaya et al., 2004; Xia et al., 2008)

Conclusion | Environmental cues

The analysed literature mainly focusses on signage, landmarks and maps and have a limited focus on colour and lighting usage.

In view of signage, the literature presents the positive effects (e.g. directional, simplify the environment & reduce anxiety), the negative effects (e.g. not noticed/inadequate &

complex) and recommendations (e.g. graphic signage & decision points). Based on the analyse regarding the negative effects of signage, the negative effects can be countered by the appropriate use of signage. The appropriate use of signage can be, placing the signage at decision points and within sightlines and in consequence helping the wayfinder notice the signs and help reduce wayfinding time.

In view of the landmarks, the literature presents the positive effects (e.g. orientation and identification & route decisions and directional cue), the fewer discussed negative effects (e.g. distance judgement & incorrect usage) and recommendation (e.g. uniqueness & decision points). Most of the articles discuss the positive effects of landmarks and these effects are similar to the positive effects of signage. They both function as a directional cue and as an orientation object, further both signage and landmark are recommended to be placed at decision points. It can be assumed that both signage and landmarks interact and will strengthen the effects when situated together. Further, the most relevant effect of signage and landmarks is that the wayfinder will experience the environment better than when using other environmental cues.

The literature on maps presents the positive effects (spatial orientation & relieve anxiety), the negative effects (more memory usage & no spatial awareness) and the recommendations (regions & landmarks). Based on the literature, a map can cause poor spatial awareness and the usage of more memory this results in a lesser experience of the environment. However, the most relevant effect of maps is the orientation effect of the maps in such manner that it can relieve anxiety (i.e. more assurance). The orientation can be enhanced by using unique landmarks on the map and the same unique landmark in the environment.

The limited literature on colour presents that salient colours can help distinguish a location in the environment. It is also recommended to use colour coding to specify locations. Based on the literature colour can be used in such manner that regions are colour coded in both the environment and on the map and thus helping the wayfinder with their orientation.

The last environmental cue lighting has also limited literature and the most discussed is the use of natural light and might be only applicable during daytime.

It can be assumed that certain environmental cues interact well with each other and make each other stronger.

4.2 | Human Factors

The consecutive paragraphs will discuss different human factors. The results will focus on gender (male, female & neutral), culture and language. Gender is the foremost mentioned factor in the articles, further culture and language are discussed in the equivalent number of articles.

Gender

The discussion of gender in wayfinding has been build upon multiple factors of the opposite sex. The articles discuss gender in three perspectives male, female and neutral.

| Male

The articles discuss that certain variables influence male wayfinders. Three different categories are distinguished regarding the male patron.

Envision | According to four different articles, males are likely to envision the environment better than females (Chebat et al., 2005; Coluccia et al 2004; Lawton, 1996; Xia et al., 2008). According to Coluccia et al. (2004), males

might perform better at wayfinding because males have a larger VSWM (Visuo-Spatial Working Memory) span.

Accuracy | Four articles focus on the accuracy of the males during wayfinding (Chang, 2015; Chebat et al., 2005; Dogu et al., 2000; Soh et al., 2004). Males make fewer errors during wayfinding and are therefore more accurate than females (Soh et al., 2004)

Survey | Three articles argue that males tend to prefer survey cues (North, East, South, West) (Hund et al., 2014; Padgitt et al., 2014; Xia et al., 2008). For example, Padgitt et al. (2014) argues that males often provide more survey cues and perform better when provided with survey cues.

| Female

Accuracy | The accuracy of wayfinding was discussed by four articles and the results are inconclusive. (Chang, 2015; Chebat et al., 2005; Padgitt et al., 2014; Soh et al., 2004). For instance, Chang (2005) and Padgitt et al. (2014) showed that females make less or similar mistakes to male. Contrary to the finding of Soh et al. (2004), Chang (2015) showed that female participants thought that they performed worse than male participants. It is important to note that Chang (2005) results show that females thought that they made more mistake, however, this was not the case.

Spatial anxiety | Anxiety is more conclusive in the articles, according to three articles females tend to have a higher anxiety level when it comes to wayfinding (Chang, 2015, Lawton, 1996; Padgitt et al., 2014). Two articles show that females reported higher levels of spatial anxiety and are likely to to have the feeling of being lost in the environment (Chang, 2015; Lawton, 1996)

Converse | Two articles established that females are likely to converse (Chebat et al, 2005; Collucia et al., 2004). According to Collucia et al. (2004), females tend to develop

their language earlier and thus likely have better conversation skills. Thus claiming that females are better at conversing, in other words, more based on verbal communication than on the visual aspects of the environment.

Route cues | Further females tend to rely on route cues (i.e. left, right) (Hund et al., 2014).

| Neutral

Twelve articles have a more neutral perspective and discussed this perspective in two topics.

Equality | Equality is discussed by multiple articles and shows that gender might not have an impact on wayfinding in a real-life situation. (Chang, 2015; Chebat et al., 2005; Coluccia et al., 2004; Dogu et al., 2000; Hund et al., 2014; Ishikawa et al., 2011; Lorenz et al., 2013; Soh et al., 2004). In both the experiments of Chang (2015) (Taiwan) and Soh et al. (2004) (Forest), gender was not found as a significant predictor of wayfinding performance.

Landmarks | The interaction of gender and landmarks was also researched by the literature (Chebat et al, 2005; Lawton, 1996; Padgitt et al., 2014; Xia et al., 2008). For example, Chebat et al. (2005) discussed that males are more likely and more accurate to use landmarks, however, also arguing that previously conducted research favours females. Contrary to findings of Xia et al. (2008) they argued that females are likely to use landmarks. The different findings are difficult to explain. Be that as it may, males were often linked to the use of landmarks due to their accuracy of pointing towards the landmarks from another location.

| Recommendation

Only one article gave a recommendation regarding gender.

Female representatives | The use of female representatives can help females feel more comfortable when asking for directions. Females are likely to ask for directions because they tend to use verbal communication (Chebat et al., 2005).

Language

The upcoming chapter will focus on language. Language has been discussed by five articles and is therefore limited. Besides the limited articles, language is not discussed in the verbal form of language but more on the physical form of language.

Navigational language | Three articles discuss the perspective of wayfinding language and the importance of a navigational language (Fendley, 2009; Fuller, 2002; Ishikawa et al., 2011). According to Fuller (2002), the use of navigational language is beneficial for wayfinding. A navigational language can be identified as a wayfinding system that is consistent in similar environments.

Left hemisphere | Only one article describes the development of language and this is in favour of females (Collucia et al., 2004). According to Coluccia et al. (2004, females tend to develop their left hemisphere earlier than males and therefore be likely to use the verbal way for navigating.

Culture

Only five articles discuss the influence of culture on wayfinding. Based upon the articles three themes could be devised. It is possible to note that culture has been approached by a broad perspective.

Modify | According to three articles, culture may modify the way people approach wayfinding (Coluccia et al., 2004;

Mottet et al., 2016; Soh et al., 2004). Coluccia et al. (2004) argue that culture in accordance with society and race strongly modify the differences between male and female when wayfinding. However, what this entails is not further discussed in the article.

Uncertainty avoidance | Two studies discussed the cultural dimension (uncertainty avoidance) and that it may impact the wayfinding (Chang, 2015; Soh et al., 2004). Chang (2015) argues that the cultural difference in uncertainty avoidance is related to wayfinding, the results of the study show that participants from western background experience a lower level of anxiety compared with the eastern participant.

Density perception | Filingeri et al. (2017), argues that crowding tolerances may be an important issue to consider when a multifaceted event is taking place.

Conclusion | Human factors

The previous category focussed on the human factors that can influence wayfinding. The eleven articles that discuss gender, are often in disagreement in which gender is better at wayfinding. However, when specific and more memory is needed to navigate men are likely to prevail. Nonetheless, memory load can be reduced by using signage and landmarks as the previous reporting have shown. Further, the relevant variable is the level of spatial anxiety of the females. The environmental cues signage and the use of maps can help in this matter.

Moreover, the discussion about language shows that language is mainly discussed as a navigational language and not as a speech-language. Navigational language can be seen as a form of wayfinding system, that is consistent throughout the environment and helps wayfinders being more confident.

Further, it was shown that women can benefit from language due to their categorisation as wayfinders that tend

to use verbal communication. This can be accommodated with the use of female representatives in the environment.

Lastly, cultural factors mainly show that it can modify wayfinding in a certain way, however, real specifics were not given. Further, two articles discuss the cultural dimension uncertainty avoidance and perceived perception. It can be assumed that uncertainty avoidance can be linked to anxiety when travelling and can thus be compensated with the right usage of signage and maps.

4.3 | Motivational strategies

Seventeen articles discuss the use of strategies and what the essence of these strategies are. Further, the articles describes the preference for certain strategies regarding gender and spatial anxiety.

Survey strategy | The survey strategy relates to the use of environmental features. Typically, locations are described in cardinal (i.e. north, south, east or west) or euclidean (10 m) descriptions and the wayfinders can typically follow natural directions (sunlight) and maintaining the sense of orientation (Coluccia et al., 2004; Hund et al., 2014; Ishikawa et al., 2011; Lawton, 1996; Padgitt et al., 2014; Soh et al., 2004; Xia et al., 2008). The survey strategy is often linked to the male species and articles show that it is related to lower spatial anxiety (Coluccia et al., 2004; Hund et al., 2014; Lawton, 1996). The effectiveness of the survey strategy is still debatable, Hund et al. (2014) found that survey cues are significantly slower and prone to error than route cues.

Route strategy | The route strategy relates to the getting instructions section by section, hence changing the viewpoint after every instruction. Most likely the instructions are given by cardinal directions (left, right, front or back) at a specific location (e.g. landmark or sign). Route strategy is often linked to the female species and is related to higher spatial

anxiety. (Coluccia et al., 2004; Hund et al., 2014; Ishikawa et al., 2011; Lawton, 1996; Li et al., 2014; Padgitt et al., 2014; Soh et al., 2004; Xia et al., 2008)

Switching strategy | Several articles discuss that it is likely that wayfinders switch their strategy according to the environment (Bailenson et al., 1998; Baskaya et al., 2004: Collucia et al., 2004; Lawton, 1996). For instance, Lawton found that wayfinders tended to switch their strategy based on the environment.

Spatial Anxiety | Spatial anxiety was already discussed in the survey strategy and the route strategy. Based on the results of the articles they show that the highness or lowness of spatial anxiety often can predict which strategy people will choose. (Coluccia et al., 2004; Hund et al., 2014; Lawton, 1996)

Other | Less often the articles discuss the effect of road climbing (Bailenson et al., 1998), efficient vs enjoyment (Baskaya et al., 2004) and verbal strategies (Baskaya et al., 2004; Fendley, 2009).

Conclusion | Motivational strategies

The category strategies consisted of five strategies and one variable that influences the chosen strategies. The most deputed strategies are survey and route strategy and are consistently reported together. More often are they described as separate strategies and not as a combination of both. When wayfinders switch strategies the articles then argue about that wayfinders switch strategy to accommodate the environment that they are in. A combination of the different strategies can likely be used in the environment. The environment should accommodate both the strategies and help the wayfinder choose the right strategy.

Likewise, as in human factors, spatial anxiety is an important variable that influences the strategy chosen.

However, the same recommendations (signage & maps) persists for relieving the anxiety.

The verbal strategy is only discussed by two articles even when it is likely that females will use this strategy. Fendley (2009) even argues that verbal strategy is the most efficient one when wayfinders are lost. The recommendation of using female representatives might help in this matter.

4.4 | Deeper insights

Stage one of this research identified some of the variables that can influence wayfinding. The second stage was for further exploration and analysing of these variables as well as finding deeper insights. The most common discussed variable that was not identified in stage one is the familiarity of the wayfinder in the environment (n=17). Further, the complexity of the environment is often discussed in the articles (n=15).

Familiarity/Unfamiliar | Seventeen articles discuss the influence of the degree of familiarity on wayfinding (Bailenson et al., 1998; Baskaya et al., 2004; Butler et al., 1993; Chang, 2015; Chebat et al., 2005; Coluccia et al., 2004; Denis et al., 2014; Dogu et al., 2000; Fendley, 2009; Fuller, 2002; Hund et al., 2014; Ishikawa et al., 2011; Lawton, 1996; Mottet et al., 2016; Soh et al., 2004; Xia et al., 2008). Butler et al. (1993), argues that familiarity with the environment reduced memory load and therefore easier to navigate and Chebat et al. (2005) found that wayfinders are more efficient when familiar with the environment. Seven articles also argue that unfamiliar wayfinders depends on navigational aids to navigate (Baskaya et al., 2004, Chang, 2015; Chebat et al., 2005; Dogu et al., 2000; Ishikawa et al., 2011; Mottet et al., 2016; Xia et al., 2008). Chang (2015), for instance, argues that wayfinders in unfamiliar

environment lacks the knowledge and therefore rely on navigation aids.

Four articles recommended how to enhance familiarity with the environment.

General knowledge | The foremost mentioned recommendation was to offer the wayfinder general knowledge before the journey (Baskaya et al., 2004; Denis et al., 2014, Fendley, 2009). Denis et al. (2000), argued that if you want to help a wayfinder give them the ability to create a visual model in advance.

Wayfinding system | Further, wayfinders can be helped by having an effective wayfinding system (Chang, 2015).

Complexity | Fifteen articles discuss the effect of complexity in an environment (Bailenson et al., 1998; Baskaya et al., 2004; Butler et al., 1993; Chang, 2015; Coluccia et al., 2004; Cope et al., 1999; Denis et al., 2014; Dogu et al., 2000; Fuller, 2002; Lawton, 1996; Li et al., 2014; Lorenz et al., 2013; Miller et al., 2000; Mottet et al., 2016 & O'Neill, 1991). Li et al. (2014), argued that a complex layout may lead to poor visibility, hence causing problems with wayfinding. Additionally, Baskaya et al. (2004) and Dogu et al. (2000) found that highly complex environment can cause stress and anxiety. Further, five of these articles discuss the impact of complexity on memory and found that it is a complex process to execute (Butler et al., 1993; Chang, 2015; Colluccia et al., 2004; Denis et al., 2014; Dogu et al., 2000). This complex process might be one of the reasons for the difficulties in wayfinding.

Based on the conclusions of the articles, three recommendations could be identified.

Decision points | The first recommendation is identical to the recommendation of signage. Namely, the placement of

orientation elements at decision points (Baskaya et al., 1998; Cope et al., 1999; Lorenz et al., 2013; O'Neill, 1991).

Regions on a map | The second recommendation is related to the design of the map. Bailenson et al. (1998), argues that by using regions on a map the working memory decreases. Thus, having more free memory to find your way.

Symmetry | Lastly, O'Neill (1991) found that symmetrical environment helped reduce the complexity of the environment. However, O'Neill (1991) also argue that the wrong usage can become repetitive.

Richness | There is likely a distinction between a complex and a richer (i.e. environment with more salient landmarks) environment because two articles discuss the positive influence of the richness of an environment (Denis et al., 2014; Lawton, 1996). Denis, argues that when the environment is has more landmarks it can result in a more memorable environment. Further Lawton, argues that when the environment is rich an orientation strategy is likely to be preferred.

Legibility | Three articles discuss the effect of the legibility of the environment (Dogu et al., 2000; Fendley, 2009; Li et al., 2014). The legibility of an environment can be described as the characteristics that contribute to the development of cognitive maps of wayfinders (Li et al., 2014).

Architecture | The environment does not only consist of external environmental cues, but it likely consists of the already available architecture (e.g. buildings, nature, roads) or the planned architecture. Dogu et al. (2000) and Peponis et al. (1990) propose that designers should not only focus on creating individual environmental cues but also work together with the architectures to create a better and a more intuitive wayfinding system.

Conclusion | Deeper insights

The category of deeper insights included variables that were not found in stage one. Nonetheless, these variables can influence the perceiving of the environment. The most important variable is the degree of familiarity with the environment followed by the complexity of the environment. Both can be seen as an important part of wayfinding. The previously reported results in environmental cues can accommodate in enhancing the degree of familiarity and influence the level of complexity. Namely, by using signage and landmarks at decision points and using regions in the environment. It can be assumed that the level of familiarity and complexity is related to the different categories: environmental cues, human factors and motivational strategies. It is therefore of importance that these variables are taken into account.

Further, the variable richness is less discussed in the articles. It can be assumed that the richness of the environment can be linked to the placement of multiple landmarks, however, this might only work when the placement of the landmarks does not increase the complexity of the environment.

Few articles discuss the impact of architecture or build environment independent of the environmental cues. Yet, the combination of these two variables can be of great importance. As already discussed with the variable signage, when the variables are designed separately it can decrease wayfinding performance. It is therefore recommended to design the environment and the environmental cues together.

STAGE FOUR | DESIGN PRINCIPLES

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Based on the systematic literature review, multiple design principles could be constructed. These design principles are created to guide, to evaluate and to inform communication specialist in wayfinding. The design principles are created as follows, the design principles will be shortly explained and will be accompanied by an illustration of how the design principles can be implemented. In order to enhance readability, no citations will be given towards the literature. All the knowledge is gained from the articles from the systematic literature review and the first stage and these are combined and reconstructed to envision the design principles.

The term 'wayfinding system' is often used in the 'for instance' section and can be describes as. A system that helps people recognise their location and guide them toward their goal, it can further strengthen peoples believe that they are traveling in the right direction. A wayfinding system can also be identified as an underlying structure that consists of the environmental cues that are used consistently throughout the environment. A good wayfinding system can work for multiple festival environments and has the ability to enhance the degree of familiarity with the wayfinders.

Familiarity |

The environment radiates familiarity to all wayfinders regardless of their experience, knowledge level and skills.

When wayfinders are more familiar with the environment, it can lead to better performance in wayfinding. Familiarity can be enhanced by environmental cues in the environment.

For instance, the possibility of sending the map of the festival beforehand can help people getting familiar with the environment. Or placing unique landmarks throughout the environment, in order to, create a cognitive map of the environment.

Points of interest |

A point of interest (intersection) communicates necessary information, helping the wayfinders to make an informed decision.

By placing environmental cues on a strategic place. Can help the wayfinder choose the right direction, and can help to recognise the place for future purposes.

For instance, by placing landmarks and signage at intersections where the wayfinder needs to make an informed decision to continue.

Complexity |

The environment itself is easy to understand for all types of wayfinders.

When the environment is complex it can cause that wayfinders have difficulties comprehending the environment and thus having problems with wayfinding.

For instance, using a consistent wayfinding system throughout the environment. The wayfinding system helps to comprehend the environment more easy because it is recognisable.

Regionalize |

The areas in the environment are regionalised and identifiable by wayfinders.

When the environment is regionalised and identifiable per area it can help the wayfinder orientate themselves in the environment.

For instance, using a colour coding method in combination with a regionalised map should help the wayfinder reduce anxiety by reducing the feeling of being lost.

Easiness |

The design reduces anxiety and helps wayfinders to be more confident.

By reducing anxiety and making the wayfinder to be more confident in the environment can help to improve the wayfinding ability of the wayfinder.

For instance, using familiar signage that is consistent with what the wayfinder expects. Or by using a map that is easy to orientate with the environment by placing unique landmarks in the environment and on the map.

Memory |

The design of the environment and elements is easy to understand and can be used with a low memory load.

By reducing the memory load the wayfinder has more free memory to focus on the environment and less likely to make mistakes.

For instance, using unique landmarks and consistent signage at decision point helps the wayfinder make the right decision and remember the location better.

Intuitive |

The wayfinding system is intuitive in use and guides wayfinders to their desired location regardless of their experience.

By making the environment intuitive for wayfinding it becomes easier for the wayfinders to make the decisions on their 'gut' feeling.

For instance, by using a constant wayfinding system that is already used in multiple occasions and thus recognisable for the wayfinder.

Directional |

The design directs wayfinders from point of interest to point of interest.

When the wayfinding system is designed bottom-up can help identify deficiencies in the system. Because deficiencies in the system can lead to backtracking and getting lost by the wayfinder.

For instance, by making a prototype of the wayfinding system beforehand and identify the problems or missing links.

Wayfinders perspective |

The design and environment are focussed on the wayfinders approach.

The environment and design are proved to work for the target group. When the target group has a better spatial awareness it can help to experience the environment more.

For instance, by testing the wayfinding system beforehand and iterating whenever a problem occurs.

Experience |

The design of the environment and cues are focussed on the whole experience.

The wayfinding system and environment are designed for experiencing the build festival environment, thus helping the wayfinder to be aware of the environment.

When all the above design principles are appropriately applied, then this would likely result in a better experience and comprehension of the environment.

DISCUSSION/IMPLICATIONS

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The main goal of this systematic literature review was to identify factors that can influence wayfinding. This was researched by reviewing articles discussing wayfinding in a particular environment. The results and the acquired knowledge of stage one were then converted into design principles regarding the festival environment.

Festivalscape | Previously stated in the introduction and in stage one, the festival environment is lacking in literature. As a consequence, the systematic literature review only obtained one article (i.e. Fillingeri et al., 2017). Therefore, additional articles on wayfinding in a festival environment are needed.

Stage one search strategy | During the first stage the focus was on obtaining basic knowledge of the factors of wayfinding. As a consequence the deeper insights were missing from the results. Fortuitously, the systematic literature review identified these variables as the degree of familiarity and the degree of complexity of an environment. The degree of familiarity has been found to be a powerful influence on wayfinding behaviour (Dogu et al., 2000), likewise, the degree of complexity has been found to influence wayfinding behaviour (Cope et al., 1999).

Search strategy | On the basis of stage one the search strategy and method was developed. It is therefore possible that certain variables are missing. The previous paragraph already discussed the variables familiarity and complexity. Nonetheless, it is still possible that certain variables were missed.

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Method| Choosing only literature that is peer reviewed can assure quality, however by only choosing peer reviewed articles 'gray' literature is missing. The possibility persist that in the 'gray' literature other variables are discussed. It is therefore recommended for further research that 'gray' literature is included.

Article selection | The search strategy in the stage two started with 11.600 articles and was reduced to 26 articles. During the refinement on title 2442 articles were excluded. On basis of the titles articles were excluded, however it might be possible that the title was misunderstood or misjudged. Leading to a wrongful termination of the article, in consequence it might be possible that an article is missing. Likewise for the other steps, the refinement on abstract and the refinement of the introduction, however, during these steps the refinement was less.

Environmental cues | Signage and landmark both have a sheer number of articles backing up the effect on wayfinding. However, lighting and colour was lacking in numbers. Both these environmental cues have limited articles discussing the effect on wayfinding and therefore missing the body of literature. Most likely, these environmental cues are discussed in other contexts and was therefore excluded in the second stage during the articles selection.

Human factors | The human factors included the variables gender, language, culture and biological factors. The majority of the articles discuss some effect of gender on wayfinding performance. Further, the systematic literature review presented very little to none articles about culture, language and biological factors. The variable biological factors (i.e. testosterone) were identified at the beginning of the search, but none of the obtained articles from the systematic literature review showed any interest in the biological factors. Nonetheless, during stage two the biological factors

where often linked with the testing with animals which was excluded from this research.

Motivational strategy | During the first stage, three strategies were identified recreational, resolute and emergency (Fewings, 2001). However, the systematic literature review identified different strategies and mainly focus on survey and route strategies. The three strategies from Fewings, are not stated in any of the articles, nonetheless, the strategies are not faulty. The discussion about survey and route strategies describes the point of view of wayfinders and how the wayfinders use different directions and cues to find their desired location. The strategies from Fewings are more related to the mindset of the wayfinder and thus providing a different perspective on strategy usage.

Design principles | The design principles reflects the findings from the analysed articles and are therefore based on the search strategy. As previously suggested it might be possible that certain variables are missing, nonetheless, this paper is only the starting point of the research in this field. This paper can be identified as an origin story, that enriches the field of wayfinding on festivals.

Different environment | The environments discussed in the articles can be categorised as an indoor and an outdoor environment. The indoor environments are hospitals, libraries, basements, universities and shopping malls, the outdoor environments are national parks and cities. The environments are mainly seen as complex environment, which is comparable with the festival environment. However, not every environment is comparable with the kind of wayfinders that festivals attract. It can be argued that festivalgoers have a different mindset, however, it might be comparable to the mindset of the shopping mall, national parks and cities. Both mindsets are mainly searching for

enjoyment in their current environment. The other environments: hospitals, libraries, basements and also shopping malls are environments where the patron, is searching for a specific item or location. Searching for a specific item or location in a complex environment can be comparable to a festival environment. Thus, the environment is not identical, yet they can deliver similar bearings as a festival environment.

Indoor and Outdoor | The discussion of the indoor and outdoor environment is likewise a point of interest. Festivals can be both indoor and outdoor, in most cases when it entails a medium/major sized festival it is likely held outside or a combination of indoor and outdoor. In other words, the applicability of indoor and outdoor wayfinding is appropriate for festivals. As long as, the wayfinding indoor and outdoor is consistent throughout the environment.

Automatic behaviour | Presumable, patrons can shift into automatic walking through the festival environment. The design principles are created to help effective wayfinding and helping patrons to recognise the wayfinding. Recognising the created wayfinding might happen when the patron is fully conscious or non-conscious. Thus, helping the patron find their way towards their location, however, it might be the possibility that the patron misses all the available wayfinding by moving subconsciously. When the patron recognises that he or she is failing to find their location, then the wayfinding system should help them backtracking or leading them towards their destination.

Night and day | Festivals can be active during the day and/ or the night, resulting in a different situations where natural light or artificial light might play a part. The sun might play a part in wayfinding if the patron is survey orientated. In such matter, that he or she is looking for the sun to orient themselves and it is night time. Then orientation needs to be

assisted through the wayfinding system. If natural light is not available, then artificial light can help to enlighten parts of the terrain.

Other factors | Other factors that have not been addressed are fatigue and drugs or alcohol usage. Fatigue and drugs or alcohol usage can negatively affect wayfinding. However, none of the factors are discussed in the found literature and it was further not included in the search strategy. The author acknowledges the influence of these variables on wayfinding However, the literature on wayfinding in a festivalscape in combination with fatigue and drugs or alcohol usage is limited, this might be because of ethics. Nonetheless the discipline of wayfinding can certainly profit if such research can be accomplished.

Crowd management | The design principles are specifically designed for creating a better experience inside a festival environment. Presumably, the link with evacuation and crowd management can be made, however, the focus of this discipline is to evacuate the crowd efficiently when danger looms. Withal, the design principles are designed for the hedonistic consumer, who are enjoying the environment and not for crowds who need to find the exits as fast as possible. Despite, that the environment may be the same, the mindset in both situations can differ considerably, which can result in different experience of the created wayfinding environment.

OVERALL CONCLUSIONS

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This research proposes wayfinding design principles for festivals based on the results of a systematic literature review. The design principles were constructed from consideration of factors and variables influencing wayfinding from other environments. Before this research, the literature on wayfinding in festival environments was limited. Thus, this research attempts to add theoretical and practical knowledge of wayfinding on festivals to the literature stream and to encourage additional research.

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APPENDIX TABLES

ENVIRONMENTAL CUES

TABLE SIGNAGE

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Author	Journal	Setting	Research Type	Sample	Literature	Findings/Discussion
Baskaya, A. Wilson, C. Özcan, Y. Z. (2004)	Environment and Behavior	Polyclinic	Quantitative Field Research	**Experiment 1:** 50 female & 23 male **Experiment 2:** 40 female & 20 male Students	Signage influence wayfinding (*Gerald Weisman, 1979, 1981*) People relied on signage (*Passini, 1980*) Signs at decision points improve wayfinding (*Peponis, Zimring & Choi, 1990*) Signage reduced received crowding, discomfort, anger and confusion (*Wener & Kaminoff, 1983*) Signage helped the wayfinding performance in the complex environment (*O'Neill, 1991a*) Signage cannot overcome architectural failure (*Arthur & Passini, 1992*) Performance decreased when number of signs increased (*Carpman, Grant & Simmons, 1984*)	Signs can help direct waypfinders through a space Signs simplify tasks A large number of signs can become to complex Signs should indicate (e.g. left, right, ahead, up and down).
Butler, D. L. Acquino, A. L. Hissong, A. A. Scott, P. A. (1993)		Human Factors	Experimental Field Experiment	52 Students		Signs can help pedestrians to form a picture of the area.
Chang, H. H. (2015)	Tourism Geographies	Taiwan	Experimental Field Experiment	86 Students	Signs systems should be direction/ orientation, identification of locations, and information (*Hart, 1985*) A destination with a complete wayfinding system including signs reduce the uncertainty of moving in a unfamiliar environment (*Caves & Pickard, 2001*) Signs help wayfinding inside a building (*Fuller, 2002*) Local signs should be graphical (*Doguh & Erkip, 2000*)	Tourist use signs to orientate and follow towards their final destination. Signs help to pay more attention to the route and environment, however it is slightly slower.

Author	Journal	Setting	Research Type	Sample	Literature	Findings/Discussion
Chebat, J. Gélinas-Chebat, C. Therrien, K. (2005)	Journal of Business Research	Shopping mall	Exploratory	156 Shoppers		Results show that not everyone notices signs. People unfamiliar with the environment will likely use signs.
Cope, J. Lutz, J. Ironsmith, M. Elbert, E (1999)	Perceptual and Motor Skills	Library	Experimental	328 Students	Shoppers describe own behaviour Signs are likely used for compensation of a complex building *(O'Neill, 1991)* Signs reduce time significantly *(Butler, Acquino, Hissong & Scott, 1990)* Signs in a complex build are useful for information *(Passini, 1980)*	
Dogu, U. Erkip, F. (2000)	Environment and Behavior	Shopping mall	Descriptive	Field Experiment		
Fendley, T. (2009)	Information Design Journal	-	Survey	78 female & 76 male Shoppers	Information is obtained with signs *(Passini, 1984)*	Signs should be created inline with the environment Signs should be composed of universal pictographs Signage is influences wayfinder significantly
Filingeri, V. Eason, K. Waterson, P. Haslam, R. (2017)	Applied Ergonomics	Lab & events	Descriptive	-	Signs should be designed appropriately *(Arthur & Passini, 2002, pp 34)*	
			Qualitative	35 participants	Ineffective signage can lead to crowd congestion and blockages *(EIF, 2014)*	Observations show that inappropriately placed signage can lead to congestion and ineffective use of space Signage should be placed at strategic positions, that provide information beforehand. Signage that is easily identifiable were place high above the crowd.

Author	Journal	Setting	Research Type	Sample	Literature	Findings/Discussion
Fuller, G. (2002)	Social Semiotics	-	Descriptive	-	Airport signage should have three functions: direction, identification, Information *(Hart, 1985)*	Signs intensify social relations Arrow are signs that assembles movement Graphical signage cools down anxiety in a unfamiliar environment Signage should be visible from expected sightlines People obey signs, whether they believe it or not
Ishikawa, T. Nakamura, U. (2011)	Spatial Cognition and Computation	Tokyo	Descriptive Field experiment	9 female & 11 male Students		People select signage as landmarks for orientation
Li, R. Klippel, A. (2012)	Journal of Map and Geography Libraries	Library	Descriptive Field Experiment	8 participants Students	Misplacing signs can increase the chance of getting lost (Carr, 2006)	Results show that signage influenced wayfinding.
Lorenz, A. Thierbach, C. Baur, N. Kolbe, T. H. (2013)	Cartography and Geographic Information Science	-	Descriptive Survey	1140 participants	Signs were found to enhance wayfinding accuracy (O'Neill, 1991)	
Miller, C. Lewis, D. (2000)	Information Design Journal	Healthcare	Descriptive Literature review Expert Survey	23 experts 885 patients and visitors		Signs prominence, legibility and illumination are important. Directional signs are a key part of wayfinding, because people heavenly relied upon them.

Author	Journal	Setting	Research Type	Sample	Literature	Findings/Discussion
O'Neill, M. J. (1991)	Environment and Behavior	University	Empirical Field experiment	21 female & 34 male Students	After simplification of signs people took significantly less time to find their destination (*Corlett, Manenica & Bishop, 1972*) Signage can reduce stress significantly (*Wener & Kaminoff, 1983*) Increase in signs decreased wayfinding performance (*Carpman et al, 1984*)	Signage is commonly employed to compensate for complex environments. Signage increased the rate of travel behaviour Signage decreased backtracking Graphical signage produced the greatest rate of travel. Textual signage was the most effective.
Peponis, J. Zimring, C. Choi, Y. K. (1990)	Environment and Behavior	Hospital	Descriptive Observations	-	-	Poor signage were often not noticed. The core of the environment should be accompanied with clear, visible and consistent signage. Signs alone can be difficult when the complexity of the environment increases. Suggested is that proper signage in combination with the environment should be a natural way of wayfinding.
Soh, B. K. Smith-Jackson, T. L. (2004)	Spatial Cognition and Computation	Forest trail	Descriptive Field experiment	8 female & 28 male	Signage design and building design is important for wayfinding (*Passini, 1996*) High salient signs are supported by park visitors (*Smith-Jackson & Hall, 2002*)	Signage increased the likelihood of correct decision making/ Signage is significant for accuracy, however not for time of decision making. Low saliency of signs caused that participants missed the signs or has difficulties reading these. Signage with distance information can aid distance judgement.
Tam, M. L. (2011)	Journal of Air Transport Management	-	Exploratory	-	Signage is a important criterion for evaluation of an airport (*Airports Council International, 2000; Correia et al, 2008*)	

Author	Journal	Setting	Research Type	Sample	Literature	Findings/Discussion
Waller, R. (2007)	Information Design Journal	Lab	Descriptive	13 female & 10 male Students	Signs are not read as continuous text *(Erik Spiekermann, 2007)* Signs should have appropriate information at the right place *(Passini, 2007)*	
			Experiment Interview Survey	Experts 4000 Participants		
Xia, J. Arrowsmith, C. Jackson, M. Cartwright, W. (2008)	Tourism Management	National Park	Descriptive	124 tourists		Directional signs are important for wayfinding. Decisions of wayfinding are based early on signs. Goal oriented waypfinders are conscious of signs.
			Field experiment			

TABLE LANDMARKS

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Author & Year	Journal	Setting	Research Type & Method	Sample	Literature	Findings/Discussion
Baskaya, A. Wilson, C. Özcan, Y. Z. (2004)	Environment and Behavior	Polyclinic	Experimental	Experiment 1: 50 female & 23 male	Plan configuration & spatial landmarks (*Gerald Weisman, 1981*)	People rely on plan configuration in an unfamiliar environment that might contain spatial landmarks.
			Field Experiment	Experiment 2: 40 female & 20 male	Cognitive mapping (*Siegel & White, 1975*)	A asymmetrical and legible configuration might facilitate wayfinding without landmarks.
			Students			Symmetrical settings does can only work with distinctive landmarks.
						Landmarks with strong character may favour identification of location.
						Errors occurred mostly at intersections, because the areas lacked landmarks.
						Graphic and spatial representations as landmarks should be complementary.
Chang, H. H. (2015)	Tourism Geographies	Taiwan	Experimental	86 Students	-	Many people like using landmarks while wayfinding
			Field Experiment			Key landmarks can improve the person's ability to traverse locations
						Landmarks are another source of wayfinding
Chebat, J. Gélinas-Chebat, C. Therrien, K. (2005)	Journal of Business Research	Shopping mall	Exploratory	156 Shoppers	Landmarks when familiar with the environment (*Appleyard, 1970*)	Utilitarian shoppers strategies are partly based on landmarks.
			Self describing			The more hedonist the shoppers, the less they use landmarks.
						Passive wayfinders, who search for landmarks tend to be more familiar with the environment and are lower hedonistic.

Appendix Tables

Author & Year	Journal	Setting	Research Type & Method	Sample	Literature	Findings/Discussion
Denis, M. Mores, C. Gras, D. Gyselinck, V. Daniel, M. (2014)	Spatial Cognition and Computation	Boulogne-Billancourt, France	Experimental Field experiment	64 Students	Objects in environment (*cf. Dudchenko, 2010*) Points of reference (*Lynch, 1960*) Status depends on navigational task (*Presson & Montello, 1988*) Navigational tool, identify points, critical actions and provide verification (*Golledge, 1999*) Identifying features, locate themselves and establish goals (*Sorrows and Hirtle, 1999*) Landmarks at decision point enhance navigation performance (*Allen, 2000*) Landmarks at decisions points, allow better long term recognition (*cf. Janzen & van Turennout, 2004; Janzen, Wagensveld, & van Turennout, 2007; Wegman & Janzen, 2011*).	A landmark is an artefact fabricated intentionally to identify a place and secure future navigation. Reference point in the environment helps moving an agents. Prominence, distinctiveness and salience are frequently cited features of landmarks High number of landmarks relates to the ability to exploit multiple options. A large number of landmarks, may enhance memory when place at reorientation points. A richter environment elicits higher recognition and a better distinguishing of landmarks. Large number of landmarks preserve the metric qualities of the learned route Environment with fewer landmarks seems to be less distinctly Landmarks should signal at that specific action have to be taken Landmarks can free up some memory Landmarks can contribute to construction of configure knowlegde.
Dogu, U. Erkip, F. (2000)	Environment and Behavior	Shopping mall	Descriptive Survey	78 female & 76 male Shoppers	Visual access to familiar cues or landmarks within or exterior to a building (*Weisman, 1981*)	Indoor landmarks are noticed by high range of respondents. Wayfinding can be partly influenced by landmarks.
Fendley, T. (2009)	Information Design Journal	-	Descriptive	-		Landmarks are useful as locators If the landmark has a name it will be easier to refer and understand it.
Fuller, G. (2002)	Social Semiotics	-	Descriptive	-		Airports are not likely to be explored through landmarks.

Author & Year	Journal	Setting	Research Type & Method	Sample	Literature	Findings/Discussion
Hund, A. M. Gill, D. M. (2014)	Journal of Environmental Psychology	Basement	Descriptive Self report Field experiment	62 female & 74 male Students	Directions with landmarks are more effective *(Denis et al., 1999, Lovelace et al., 1999; Hölscher, Tenbrink, & Wiener, 2011; Hund & Padgitt, 2010; Padgitt & Hund, 2012; Ward, Newcombe, & Overton, 1986)*	Results show that with route cues the destination was found significantly faster Landmarks are the most helpful Landmarks can work in both route and survey descriptions.
Ishikawa, T. Nakamura, U. (2011)	Spatial Cognition and Computation	Tokyo	Descriptive Field experiment	9 female & 11 male Students	Singularity and uniqueness *(Lynch, 1960)* Visual, cognitive and structural prominence *(Sorrow & Hirtle, 1999)* Selected at or near intersections *(Denis, Pazzaglia, Cornoldi & Bertolo, 1999)*	Locations can be identified by landmarks Landmarks were selected at intersections Landmarks can also serve as course maintenance purposes Colour and novelty are the most selected landmarks Participants with good sense of direction selected fewer landmarks
Lawton, C. A. (1996)	Journal of Environmental Psychology	Campus building	Descriptive Field experiment	174 female & 104 male Students	-	In rich environments with landmarks route strategy will be most likely be preferred.
Lorenz, A. Thierbach, C. Baur, N. Kolbe, T. H. (2013)	Cartography and Geographic Information Science	-	Descriptive Survey	1140 participants	-	Landmarks that contrast the environment are easier to remember. Global landmarks are visible and used for orientation, local landmark are situated along the route and are for verification.
Miller, C. Lewis, D. (2000)	Information Design Journal	Healthcare	Descriptive Literature review Expert Survey	23 experts 885 patients and visitors	-	Effective landmarks are noticeable, prominent, memorable, describable and unusual in the environment, Landmarks are used for orientation and a reference point.

Author & Year	Journal	Setting	Research Type & Method	Sample	Literature	Findings/Discussion
Mottet, M. Eccles, D. W. Saury, J. (2016)	Spatial Cognition and Computation	Outside	Descriptive / Course of action	8 male / Students	Distance can be jugded longer when the route has many landmarks *(Thorndyke, 1981)*	"There I have no landmark; I have a feeling everything looks the same [...]."
Padgitt, A. J. Hund, A. M. (2012)	Journal of Environmental Psychology	Lab	Descriptive / Self report	24 female & 29 male / Students	Wayfinding error occur less when landmarks are at choice points *(Allen, 2000)*	Landmark can be at choice points or at non choice points. Findings confirm that the preference for route descriptions (left-rights and landmarks at choice points) are preferred.
Soh, B. K. Smith-Jackson, T. L. (2004)	Spatial Cognition and Computation	Forest trail	Descripive / Field Experiment	8 female & 28 male	Landmarks might aid novices while wayfinding *(Crampton, 1992)*	Participants spent lesser time at junctions with prominent landmarks.
Xia, J. Arrowsmith, C. Jackson, M. Cartwright, W. (2008)	Tourism Management	National Park	Descripte / Field Experiment	124 tourists	Landmarks are salient object for referencing *(Sorrow & Hirtle, 1999)* Singularity, distinct qualities *(Lynch, 1960; Raubal & Winter, 2002; Saaty, 1980).* Decision points *(Jackson, 1998)*	People may use landmarks to remember and recognise. Landmarks act as an aid for recognition. Landmarks facilitate directional change. Incorrect landmarks can result in wrong decisions. The results suggests that familiarity is related to the type of landmarks used.

TABLE MAPS

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Author	Journal	Setting	Research Type	Sample	Literature	Findings/Discussion
Bailenson, J.N. Shum, M.S. Uttal, D.H. (1998)	Journal of Environmental Psychology	Lab	Qualitative Experiment	*First experiment* 18 females & 6 male *Second experiment* 39 female & 31 male		Subjects chose routes on maps that were segmented into regions. Road climbing occurred when choosing a route from a map. Road climbing occur more on regionalised maps
Butler, D. L. Acquino, A. L. Hissong, A. A. Scott, P. A. (1993)	Human Factors	Basement	Experimental Field Experiment	52 Students		The you-are-here map is slower than no navigational aids. Subjects using a map need to memorise more.
Chang, H. H. (2015)	Tourism Geographies	Taiwan	Experimental Field Experiment	86 Students	Subjects were more certain about their location when using a map. Maps can help orientate if knowledge is acquired *(Roskos-Ewoldsen, McNamara, Shelton, & Carr, 1998; Sholl, 1988;Thorndyke & Hayes-Roth, 1982)*	Maps facilitate the configurational understanding of an environment however it requires an other learning process. Maps can be used to plan the route in advance. Participants took more time to memorise maps beforehand the experiment. Maps users were most efficient in wayfinding, however worst in spatial awareness.
Coluccia, E. Louse, G. (2004)	Journal of Environmental Psychology	-	Quantitative	-	When the environment is represented by a map males might perform better. *(McGuinness & Sparks, 1983; Miller & Santoni, 1986; Ward, Newcombe, & Overton, 1986; O'Laughlin & Brubaker, 1998; Galea & Kimura, 1993; Dabbs, Chang, & Strong, 1998; Brown et al., 1998; Coluccia & Martello, 2004)*	Performance of males can be better with maps than females. Difference emerged when the map was not visible, increasing the memory load.

Appendix Tables

Author	Journal	Setting	Research Type	Sample	Literature	Findings/Discussion
Dogu, U. Erkip, F. (2000)	Environment and Behavior	Shopping mall	Descriptive Survey	78 female & 76 male Shoppers	Maps can be seen as a support for a useful wayfinding system. *(Passini, 1984)*	You-Are-Here maps were found useful, however very often poorly positioned.
Fendley, T. (2009)	Information Design Journal	-	Descriptive	-		A map divided into areas can help the wayfinder. Using orientated maps can help reduce mental transformation. People need the map to connect with the environment and orientate themselves. Proper design of maps can be challenging. Maps is a way to provide a guide not a scaled version of reality.
Fuller, G. (2002)	Social Semiotics	-	Descriptive	-		Maps are about movement and connection.
Hund, A. M. Gill, D. M. (2014)	Journal of Environmental Psychology	Basement	Descriptive Self Report Field Experiment	62 female & 74 male Students	Individuals who scored higher on mental rotation ability might be better at learning maps *(De Beni, Pazzaglia & Gardini, 2006)*	
Ishikawa, T. Nakamura, U. (2011)	Spatial Cognition and Computation	Tokyo	Descriptive Field Experiment	9 female & 11 male Students		Without accomplishing spatial orientation, it can be hard to find the route and use maps to align with the environment.
Li, R. Klippel, A. (2012)	Journal of Map and Geography Libraries	Library	Descriptive Field Experiment	8 participants Students	If it is hard to align the map with the environment the cognitive load increases *(Levine, 1982; Waren & Scott, 1993; Shepard & Hurwitz, 1984)*	Maps can be used to provide general location of the major areas.

Author	Journal	Setting	Research Type	Sample	Literature	Findings/Discussion
Lorenz, A. Thierbach, C. Baur, N. Kolbe, T. H. (2013)	Cartography and Geographic Information Science	-	Descriptive Survey	1140 participants		3D maps have a considerable advantage in an environment. Landmark added to a complex map was regarded as unhelpful. Good map design is found essential for wayfinding.
Miller, C. Lewis, D. (2000)	Information Design Journal	Healthcare	Descriptive Literature Review Expert Survey	23 experts 885 patients and visitors		Maps van be helpful when people are unfamiliar with the environment and provide some assurance.
Mottet, M. Eccles, D. W. Saury, J. (2016)	Spatial Cognition and Computation	Outside	Descriptive Course of Action	8 male Students	Unfamiliar environment may require maps for successful navigation *(Montello, 2005)*	Maps were found to boost confidence when participants could align them with the environment.
Soh, B. K. Smith-Jackson, T. L. (2004)	Spatial Cognition and Computation	Forest trail	Exploratory Field Experiment	8 female & 28 male	Using a paper map is a complex cognitive task *(Blades & Spencer, 1987)*	When lost, participants used the map to align with the features of the environment. All participants rotated their map when they navigated Map design should be design for the target users and their capabilities and limitations.

TABLE COLOUR

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Author & Year	Journal	Setting	Research Type & Method	Sample	Literature	Findings/Discussion
Baskaya, A., Wilson, C., Özcan, Y. Z. (2004)	Environment and Behavior	Polyclinic	Experimental	Experiment 1: 50 female & 23 male; Experiment 2: 40 female & 20 male	Distinctiveness can be achieved by colours *(Arthur and Passini, 1992)*	Coloured elements can help understand the spatial organisation of the building; Colour codes can be used as reference points to make each space different
Cope, J. Lutz, J. Ironsmith, M. Elbert, E. (1999)	Perceptual and Motor Skills	Library	Field Experiment; Experimental	Students; 328 Students	Building interior memory may improve with the use of colour schemes *(Evans, 1980)*	If used correctly the wayfinding element can be visible, yet blend into the environment.
Dogu, U. Erkip, F. (2000)	Environment and Behavior	Shopping mall	Descriptive; Survey	78 female & 76 male; Shoppers	Contrast of the coloured elements contributes to the comprehension of the space *(Passini, 1984)*	Brightly colours can fatigue the eye, however it attract the eye. Too many eye-catchers can be confusing
Fendley, T. (2009)	Information Design Journal	-	Descriptive	-		Too much colour can cause confusion, when there is no singular appearance.
Fuller, G. (2002)	Social Semiotics	-	Descriptive	-		Coloured lines can designate a strict line of traffic.
Ishikawa, T. Nakamura, U. (2011)	Spatial Cognition and Computation	Tokyo	Descriptive; Field experiment	9 female & 11 male; Students		Coloured objects are often selected as landmarks.
Li, R. Klippel, A. (2012)	Journal of Map and Geography Libraries	Library	Descriptive; Field experiment	8 participants; Students	Colours of architectural styles can partly help wayfinders distinguish locations *(Evan et al, 1984)*	In a library colour codes can be used to specify an certain location

Author & Year	Journal	Setting	Research Type & Method	Sample	Literature	Findings/Discussion
Miller, C. Lewis, D. (2000)	Information Design Journal	Healthcare	Descriptive Literature review Expert Survey	23 experts 885 patients and visitors		Low colour contrast can reduce legibility Colour coding is not often noticed by people However colour coding was found to be effective when noticed by the visitors.
Soh, B. K. Smith-Jackson, T. L. (2004)	Spatial Cognition and Computation	Forest trail	Descriptive Field Experiment	8 female & 28 male	Colored maps support discrimination between map features *(Keates, 1982)* High percentage preferred colours maps *(1989)* Coloured maps might not be essential because it did not decrease or increase wayfinding performance *(Delvin & Bernstein, 1997)* Highly salient (e.g. bright colours) are supported by the trail visitors *(Smith-Jackson & Hall, 2002)*	Users preferred colours maps Map colour was not found to improve wayfinding performance. But it was found that colour help discriminate between features
Waller, R. (2007)	Information Design Journal	Lab	Descripive Experiment Interview Survey	13 female & 10 male Students Experts 4000 Participants		Contrast is the most important factor and black on white was the best. The result showed an overwhelming preference for black on yellow. Colour combination give maximum legibility and contrast according to reviewers.

TABLE LIGHTING

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Author	Journal	Setting	Research Type	Sample	Literature	Findings/Discussion
Baskaya, A. Wilson, C. Özcan, Y. Z. (2004)	Environment and Behavior	Polyclinic	Experimental Field Experiment	Experiment 1: 50 female & 23 male Experiment 2: 40 female & 20 male Students		Respondents argued that they needed more natural light
Dogu, U. Erkip, F. (2000)	Environment and Behavior	Shopping mall	Descriptive Survey	78 female & 76 male Shoppers	Distinctiveness can be achieved by using light (*Arthur & Passini*)	Lighting has not been found statistically significant for evaluation of wayfinding.
Fuller, G. (2002)	Social Semiotics	-	Descriptive	-		Lights are being internationalised in semiotic wayfinding technologies
Miller, C. Lewis, D. (2000)	Information Design Journal	Healthcare	Descriptive Literature review Expert Survey	23 experts 885 patients and visitors		Entrances of building were more prominent by good lighting. Wrong lighting could cause difficulties in readability of signs Good use of lights can be used as an effective tool for wayfinding
Xia, J. Arrowsmith, C. Jackson, M. Cartwright, W. (2008)	Tourism Management	National Park	Descriptive Field Experiment	124 tourists		Some directional changes by wayfinders are not easy to determine because they focus on light of the sun.

HUMAN FACTORS

TABLE GENDER

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Author / Year	Journal	Setting	Research Type	Sample	Findings/Discussion
Chang, H. H. (2015)	Tourism Geographies	Taiwan	Field Experiment	86 Students	**Neutral** Results showed that both female and male participants performed equally. **Female** Females had a higher anxiety level and they tended to think that they made mistakes, though this was not the case.
Chebat, J. Gélinas-Chebat, C. Therrien, K. (2005)	Journal of Business Research	Shopping mall	Shoppers describe own behaviour	156 Shoppers	**Neutral** *Lawton et al. (1996) & Dogu and Erkip (2000)* found no gender difference. **Female** Females use more people as information source and rely on verbal messages. Females are likely less skilled in the use of maps *(e.g., Ward et al., 1986; Harrell et al., 2000).* *Recommended that the information kiosk use female employees.* *Females tend to recall and use landmarks more* **Male** Males use more landmarks and walk more when they are highly hedonistic Males have better skills in mentally imaging their environment. Males are more accurate locating landmarks
Coluccia, E. Louse, G. (2004)	Journal of Environmental Psychology	-	Systematic Literature Review	-	**Neutral** Society, culture, race, etc. can strongly modify gender difference. When Visuo-Spatial Working Memory (VSWM) is low the gender difference would disappear. **Male** Males have a higher VSWM span and therefore better at orientation.

Author / Year	Journal	Setting	Research Type	Sample	Findings/Discussion
Dogu, U. Erkip, F. (2000)	Environment and Behavior	Shopping mall	Survey	78 female & 76 male Shoppers	**Neutral** Both men and women are accurate at the pointing task. **Female** Women were likely more familiar with the environment regarding the accuracy. **Male** Male who found the signage sufficient also reported easy wayfinding.
Hund, A. M. Gill, D. M. (2014)	Journal of Environmental Psychology	Basement	Self report, Field experiment	62 female & 74 male Students	**Neutral** Gender has no time difference **Female** Women were more quickly with the use of route cues. **Male** No difference was found in wayfinding time with the use of survey strategies.
Ishikawa, T. Nakamura, U. (2011)	Spatial Cognition and Computation	Tokyo	Field experiment	9 female & 11 male Students	**Neutral** No significant gender difference was found concerning landmark selection.
Lawton, C. A. (1996)	Journal of Environmental Psychology	Campus building	Field Experiment	174 female & 104 male Students	**Female** Women reported reliance on indoor route strategy and a higher level of spatial anxiety **Male** Men are more accurate at pointing at unseen landmarks.
Lorenz, A. Thierbach, C. Baur, N. Kolbe, T. H. (2013)	Cartography and Geographic Information Science	-	Survey	1140 participants	**Neutral** Gender seems to influence wayfinding, however this was not tested.

Author / Year	Journal	Setting	Research Type	Sample	Findings/Discussion
Padgitt, A. J. Hund, A. M. (2012)	Journal of Environmental Psychology	Lab	Self report	24 female & 29 male	**Female** Women provide more landmark information than men. Women perform better with landmarks Women had lower wayfinding errors **Male** Men provide more cardinal descriptions and likely preform better with them.
Soh, B. K. Smith-Jackson, T. L. (2004)	Spatial Cognition and Computation	Forest trail	Field Experiment	44 female & 49 male Students 8 female & 28 male	**Neutral** Gender was not found to be a significant predictor of wayfinding. **Female** Females were found to take longer and are less accurate (***Galea and Kimura, 1993***) **Male** Males are more confident in wayfinding (***Pedersen, 1999***) Males use different wayfinding strategies.
Xia, J. Arrowsmith, C. Jackson, M. Cartwright, W. (2008)	Tourism Management	National Park	Field Experiment	124 tourists	**Female** Women prefer the use of landmarks and are more reliant on their memory to identify the landmarks. **Male** Man are more accurate in landmark location and the use of cardinal directions (***Lawton & Kallai, 2002***)

TABLE LANGUAGE

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Author	Journal	Setting	Research Type	Sample	Literature	Findings/Discussion
Coluccia, E. Louse, G. (2004)	Journal of Environmental Psychology	-	Quantitative	-	Females benefit from earlier development of the left hemisphere and there have an advantage in verbal strategies *(Annet, 1992)*	
Fendley, T. (2009)	Information Design Journal	-	Descriptive	-		Navigational language should help connect the information of the journey.
Fuller, G. (2002)	Social Semiotics	-	Descriptive	-	Language should be a map *(Deleuze & Guattari, 1998: 77)*	Airport language is an interface for social relations. Signage should be created with the language in mind. Language should be a map (
Ishikawa, T. Nakamura, U. (2011)	Spatial Cognition and Computation	Tokyo	Descriptive Field experiment	9 female & 11 male Students	Cardinal direction are sometime easier for people with a certain language *(Levinson, 2003)*	

TABLE CULTURE

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Author & Year	Journal	Setting	Research Type & Method	Sample	Literature	Findings/Discussion
Chang, H. H. (2015)	Tourism Geographies	Taiwan	Experimental Field Experiment	86 Students	Asian and western cultures have significant differences (*Reisinger & Turner, 2003*)	Results show that participant of western culture experience a lower lover of anxiety.
Coluccia, E. Louse, G. (2004)	Journal of Environmental Psychology	-	Quantitative Systematic Literature Review	-	The cultural dimension of uncertainty avoidance and travel behaviour are different our culture (*Money & Crotts, 2003*)	Culture was strongly modifies differences between males and females.
Filingeri, V. Eason, K. Waterson, P. Haslam, R. (2017)	Applied Ergonomics	Lab & events	Qualitative Focus group, Observations	35 participants	Findings support that culture contributes to perceived positive and negative effects of density (*Whiting & Nakos, 2008*)	Culture contributes to the perception of crowd density Signage can help emphasising cultural norms.
Mottet, M. Eccles, D. W. Saury, J. (2016)	Spatial Cognition and Computation	Outside	Descriptive Course of action	8 male Students		Cultural context can explain the south out signs.
Soh, B. K. Smith-Jackson, T. L. (2004)	Spatial Cognition and Computation	Forest trail	Descriptive Field Experiment	8 female & 28 male		Cultural difference was found to be a significant predictor of accuracy of decision making and time deviated from the route, International participants were observed and showed difficulties in understanding names and reading sings.

MOTIVATIONAL STRATEGIES

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TABLE STRATEGIES

Author	Journal	Setting	Research Type	Sample	Literature	Findings/ Discussion
Bailenson, J.N. Shum, M.S. Uttal, D.H. (1998)	Journal of Environmental Psychology	Lab	Experiment	*First experiment* 18 females & 6 male; *Second experiment* 39 female & 31 male	Route climbing can also reduce the amount of information that needs to be processes (*Christenfeld, 1995*)	People use specific strategies. Route climbing is a localised strategy where people try to minimise the energy needed to solve the problem. Route climbing can lead to asymmetries in route choice. People seem concerned with picking the longest and straightest route toward their goal, however, switch strategies when nearing this goal.
Butler, D. L. Acquino, A. L. Hissong, A. A. Scott, P. A. (1993)	Human Factors	Basement	Field Experiment	52 Students		Participants preferred routes that minimised energy.
Baskaya, A. Wilson, C. Özcan, Y. Z. (2004)	Environment and Behavior	Polyclinic	Field Experiment	Experiment 1: 50 female & 23 male; Experiment 2: 40 female & 20 male; Students	Participants use the strategy that consisted out of three factors: orientation, route and building configuration (*Lawton, 1996*)	
Chang, H. H. (2015)	Tourism Geographies	Taiwan	Field Experiment	86 Students	Participants from different countries used different strategies (*Lawton & Kallai, 2002*)	Strategies used in the experiment are local signs, maps and gps.
Chebat, J. Gélinas-Chebat, C. Therrien, K. (2005)	Journal of Business Research	Shopping mall	Shoppers describe own behaviour	156 Shoppers		Women tend to explore the environment and rely on the landmarks and men tend to rely on their sketch map ability. Utilitarian shoppers strategies are solving problems efficiently and are based on landmarks and persons. Hedonist shoppers strategies are for enjoyment and experiencing.

Author	Journal	Setting	Research Type	Sample	Literature	Findings/ Discussion
Coluccia, E. Louse, G. (2004)	Journal of Environmental Psychology	-	Systematic Literature Review	-	Men prefer euclidean strategies ***(Lawton, 1994)*** Males have a lower level of anxiety and female have a higher anxiety ***(Schmitz, 1997)*** People with high level of spatial anxiety rely more on route strategies ***(Lawton, 1994)***	Males rely on survey strategies and females on route strategies. Males often swap strategies the necessary and are better at spatial orientation.
Fendley, T. (2009)	Information Design Journal	-	Descriptive	-		The participant learned the geographic information in regions. The quickest strategy was asking for help.
Hund, A. M. Gill, D. M. (2014)	Journal of Environmental Psychology	Basement	Self report, Field experiment	62 female & 74 male Students	Survey strategy was correlated with better wayfinding performance ***(Chai & Jacobs, 2009; Hund & Minarik, 2006; Hund, Haney & Seanor, 2008)*** People with a good sense of direction adopt a strategy for a given environment ***(Kato & Takeuchi, 2003)***	Route strategy locations are typically described in descriptions like left right front and back. Survey strategy locations are typically described in descriptions like north, east, south, west or distances. Spatial anxiety is negatively related to survey strategy and vice versa. Route strategy elicited higher effectiveness and more efficient wayfinding Survey strategies is related to mental rotation. Women were more quickly when using the route strategy.
Ishikawa, T. Nakamura, U. (2011)	Spatial Cognition and Computation	Tokyo	Field experiment	9 female & 11 male Students		Good and poor sense of direction differ in the use of strategies.

Author	Journal	Setting	Research Type	Sample	Literature	Findings/ Discussion
Lawton, C. A. (1996)	Journal of Environmental Psychology	Campus building	Field experiment	174 female & 104 male	Individuals who use survey strategies report lower levels of spatial anxiety *(Lawton, 1994)*	Route strategy focusses on information about the route (e.g. right or left)
		Students		Students	Individuals often shift strategies when they become more familiar with the environment *(Bethell-Fox & Shepard, 1988)*	Men were likely to use the survey strategy and women were likely to use the route strategy.
						People tend to use similar wayfinding strategies for both indoor and outdoor.
						People might switch between strategies.
Li, R. Klippel, A. (2012)	Journal of Map and Geography Libraries	Library	Field experiment	8 participants Students	Space syntax could explain the preference for a certain wayfinding strategy *(Hölscher et al., 2016)*	
Mottet, M. Eccles, D. W. Saury, J. (2016)	Spatial Cognition and Computation	Outside	Course of action	8 male Students		Novice orienteers strategy was not based on a rational and Euclidean assessment of distances.
Padgitt, A. J. Hund, A. M. (2012)	Journal of Environmental Psychology	Lab	Self report	24 female & 29 male Students		Men prefer survey strategies and women prefer route strategies *(Honda & Nihei; 2004; Hund & Minarik, 2006; Hund et al., 2008; Lawton & Kallai, 2002)*
Soh, B. K. Smith-Jackson, T. L (2004)	Spatial Cognition and Computation	Forest trail	Field Experiment	8 female & 28 male	Experts gain survey knowledge and novices gain route base knowledge *(Crampton)*	Sense of direction was positively correlated with survey strategy and negatively with the route strategy
						Participant showed that they usually employ simple processes such as orientating and structural matching.
Xia, J. Arrowsmith, C. Jackson, M. Cartwright, W. (2008)	Tourism Management	National Park	Field Experiment	124 tourists	People may not be completely conscious of using a specific wayfinding strategy *(Golledge, 1999)*	Participants primarily selected roads that appeared different from the previous ones.

DEEPER INSIGHTS

TABLE ENVIRONMENT

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Author	Journal	Setting	Research Type	Sample	Literature	Discussion/Findings
Bailenson, J.N. Shum, M.S. Uttal, D.H. (1998)	Journal of Environmental Psychology	Lab	Qualitative Experiment	*First experiment* 18 females & 6 male *Second experiment* 39 female & 31 male		The environment did not impact the route selected.
Baskaya, A. Wilson, C. Özcan, Y. Z. (2004)	Environment and Behavior	Polyclinic	Quantitative Field experiment	**Experiment 1:** 50 female & 23 male **Experiment 2:** 40 female & 20 male Students	The ease of forming a cognitive map was related to simplicity or the gestalt *(McKean, 1972; Weisman, 1981)* Pictorial differentiation is needed for forming a clear environmental image *(Abu-Obeid,1998)* The structure of the environment has a strong influence on wayfinding behaviour *(Seidel, 1982)* Views of external environment can enhance the legibility *(Garling et al, 1986)*	In an unexperienced environment the comprehension of the spatial configuration is important and therefore rely on environmental information. Higher levels of configuration understanding is associated with more efficient wayfinding performance. Symmetry can lead to lack of confidence and anxious walks. It is suggested that spatial distinctiveness is needed for environments.
Chang, H. H. (2015)	Tourism Geographies	Taiwan	Experimental Field experiment	86 Students		Each wayfinding process includes storing knowledge about the environment in order to facilitate recognition. Maps can reduce anxiety All forms of travel require the person to identify itself with the environment. GPS helps with positioning

Author	Journal	Setting	Research Type	Sample	Literature	Discussion/Findings
Chebat, J. Gélinas-Chebat, C. Therrien, K. (2005)	Journal of Business Research	Shopping mall	Exploratory	156 Shoppers		Individual form cognitive maps of the environment for planning their upcoming actions
		Shoppers describe own behaviour				The legibility of the environment affects the utilisation shoppers more.
						Men are better in mentally imaging their environment.
						Visualisers use the information features of the environment.
						Emotional relation with the environment can effect some environmental cues.
Coluccia, E. Louse, G. (2004)	Journal of Environmental Psychology	-	Quantitative	-		Active participation with the environment increases the complexity of the task.
			Systematic literature			
Cope, J. Lutz, J. Ironsmith, M. Elbert, E (1999)	Perceptual and Motor Skills	Library	Experimental	328 Students	The characteristics of the environment affect wayfinding are:	The environment plays an important part in solving wayfinding.
			Field experiment		The complexity and wayfinding cues.	
					(e.g., see Arthur & Passini, 1992; Peponis, Zimring, & Choi, 1990; Talbot, Kaplan, Kuo, & Kaplan, 1993 for representative findings).	

Author	Journal	Setting	Research Type	Sample	Literature	Discussion/Findings
Denis, M. Mores, C. Gras, D. Gyselinck, V. Daniel, M. (2014)	Spatial Cognition and Computation	Boulogne-Billiancour, France	Experimental Field experiment	64 Students		The memorability of an environment can be contribute by the nature and content of the experience whilst navigating. Richer environments are likely helping richer and more available memories. Helping people creating a visual model in advance can help wayfinding. A richer environment has higher recognition scores, but also better capacity of distinguishing between landmarks.
Dogu, U. Erkip, F. (2000)	Environment and Behavior	Shopping mall	Descriptive Survey	78 female & 76 male Shoppers	Factors such as age, gender, occupation, individual psychology and familiarity has been found to affect people wayfinding in the environment (*O'Neill, 1991; Peponis, Zimring, & Choi, 1990; Weisman, 1981*). Environmental features that aid spatial understanding is preferred by people (*Kaplan, 1975*)	Problems can occur when people are processing information from the environment. Quality of an environment is referred to as legibility Recognition is not possible unless the environment is somewhat familiar Some environmental information can evaluated by architecture, graphic and verbal information. Environmental graphic designers and architects should work together.
Fendley, T. (2009)	Information Design Journal	-	Descriptive	-		Feeling lost is a negative feeling and can induces stress and panic. Information should be design for normal environmental perception.
Filingeri, V. Eason, K. Waterson, P. Haslam, R. (2017)	Applied Ergonomics	Lab & events	Qualitative Focus groups Observations	35 participants		Physical design has important implication for the peoples experience. A lack of sufficient personal space in a crowded environment is a negative experience.

Author	Journal	Setting	Research Type	Sample	Literature	Discussion/Findings
Hund, A. M. Gill, D. M. (2014)	Journal of Environmental Psychology	Basement	Descriptive Self report Field experiment	62 female & 74 male Students	Sense of direction is the confidence of keeping track of the location *(Kozlowski & Bryant, 1977)*	Large environment can benefit from a similar wayfinding application. Suggested is providing wayfinding beforehand can help people understand the environment. Providing flexibility in the presentation of cues can enhance wayfinding.
Ishikawa, T. Nakamura, U. (2011)	Spatial Cognition and Computation	Tokyo	Descriptive Field experiment	9 female & 11 male Students	Identifying location in large environment is necessary for wayfinding *(Montello, 2005)*	Knowledge of the environment help detect certain points for navigation.
Lawton, C. A. (1996)	Journal of Environmental Psychology	Campus building	Descriptive Field experiment	174 female & 104 male Students	The ability to maintain orientation within the spatial environment varies widely between individuals *(e.g. Brown, 1932; Kozlowski & Bryant, 1977; Weisman, 1981; Hirtle & Hudson, 1991; Montello & Pick, 1993).*	A possibility in differences between individuals is that they focus on different types of information. Strategy switch in rich environments are possible.
Li, R. Klippel, A. (2012)	Journal of Map and Geography Libraries	Library	Descriptive Field experiment	8 participants Students	Legibility describes that characteristics of different environment contribute differently to wayfinding behaviour *(Lynch, 1960)*	Three important aspects of an environments are: visibility, connectivity and layout complexity. The environment influences the wayfinding performance.
Miller, C. Lewis, D. (2000)	Information Design Journal	Healthcare	Descriptive Literature review Experts Survey	23 experts 885 patients and visitors		Getting lost generates frustration, anxiety and negative attitude towards the environment.
Mottet, M. Eccles, D. W. Saury, J. (2016)	Spatial Cognition and Computation	Outside	Descriptive Course of action	8 male Students		Environment are sometimes too large to be perceived in full from one single point of view. Participants felt that they had no meaningful feature in the environment to locate themselves.

Author	Journal	Setting	Research Type	Sample	Literature	Discussion/Findings
Padgitt, A. J. Hund, A. M. (2012)	Journal of Environmental Psychology	Lab	Descriptive

Self report | 24 female & 29 male

Students | Landmarks can help construct a visual model of the environment (**Tom & Denis, 2004**) | Participants viewed the environment with a survey perspective, because of the visibility of the entire environment during the task.

Good sense of direction is related to active exploring and remembering more details of the environment.

Indoor environments might need a route perspective and outdoor more survey perspective.

People with poor sense of direction can overcome shortcomings with training and preparation. |
| **Tam, M. L. (2011)** | Journal of Air Transport Management | - | Exploratory | - | | The model can be applied to certain environments for determining the appropriate locations for wayfinding aids. |
| **Waller, R. (2007)** | Information Design Journal | Lab | Descriptive

Experiment
Interview
Survey | 13 female & 10 male Students

Experts

4000 Participants | | Appropriate lighting of the signs for an airport environment is needed.

Authoritative fonts can be of importance in certain environments |

TABLE DEGREE OF FAMILIARITY

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Author & Year	Journal	Setting	Research Type & Method	Sample	Literature	Findings/Discussion
Bailenson, J.N. Shum, M.S. Uttal, D.H. **(1998)**	Journal of Environmental Psychology	Lab	Qualitative Experiment	*First experiment* 18 females & 6 male *Second experiment* 39 female & 31 male	Familiarity influences wayfinding decisions *(O'Neil, 1992)*	Subjects were consistent using the selected route even when the environment was unfamiliar.
Baskaya, A. Wilson, C. Özcan, Y. Z. **(2004)**	Environment and Behavior	Polyclinic	Quantitative Field Experiment	**Experiment 1:** 50 female & 23 male **Experiment 2:** 40 female & 20 male Students	As familiarity increases, both accuracy and performance of wayfinding increases *(Bryant, 1982; O'Neill, 1992)* In an unfamiliar environment people rely on configuration *(Lawton, 1996)* General knowledge of a building helps people orientate *(Gross & Zimring, 1992)*	The degree of familiarity with the environment influence wayfinding. Depending on the situation of the wayfinder, an unfamiliar setting can be more difficult.
Butler, D. L. Acquino, A. L. Hissong, A. A. Scott, P. A. **(1993)**	Human Factors	Basement	Experimental Field Experiment	52 Students		If wayfinders are somewhat familiar with the environment their memory load reduces.

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Author & Year	Journal	Setting	Research Type & Method	Sample	Literature	Findings/Discussion
Chang, H. H. (2015)	Tourism Geographies	Taiwan	Experimental / Field Experiment	86 Students	Sometimes people rely on others when they are in an unfamiliar environment *(Hund & Minarik, 2006)*	Wayfinding is a human behaviour when people enter an unfamiliar environment
					Using a wayfinding system will help decrease uncertainty of moving in a unfamiliar environment *(Caves & Pickard, 2001)*	Wayfinders require a complex cognitive process finding their way in an unfamiliar environment.
					Learning an unfamiliar environment is a complex activity *(Walmsley & Jenkins, 1992)*	When in an unfamiliar environment there is an absence of knowledge and thus relying on navigation aids.
					Familiarising wayfinders beforehand can have positive effects *(Guy, Curtis & Crotts, 1990)*	Travel experience can influence to how comfortable some people are in an unfamiliar environment.
Chebat, J. Gélinas-Chebat, C. Therrien, K. (2005)	Journal of Business Research	Shopping mall	Exploratory / Shoppers describe own behaviour	156 Shoppers	People unfamiliar with the environment will use external sources and people familiar with the environment use the stored knowledge more *(Abu-Gazzeh, 1996; Garling et al, 1986)*	Wayfinders familiar with the environment are more efficient in reaching their goal.
						Unfamiliar wayfinders will likely make more mistake and use more external sources.
						Familiar wayfinders will likely use more stored knowledge and follow their instincts.
Coluccia, E. Louse, G. (2004)	Journal of Environmental Psychology	-	Quantitative / Systematic literature review	-	Anxiety in a unfamiliar environment can have a negative impact on confidence and wayfaring *(Bryant, 1982, 1991)*	It is suggested that familiarity can cause gender differences in some studies.
Denis, M. Mores, C. Gras, D. Gyselinck, V. Daniel, M. (2014)	Spatial Cognition and Computation	Boulogne-Billiancourt, France	Experimental / Field Experiment	64 Students		Helping the wayfinder in an unfamiliar environment involves helping them create a visual model in advance.

Appendix Tables

Author & Year	Journal	Setting	Research Type & Method	Sample	Literature	Findings/Discussion
Dogu, U. Erkip, F (2000)	Environment and Behavior	Shopping mall	Descriptive Survey	78 female & 76 male Shoppers	Visual acmes to familiar cues or landmark influence wayfinding Is familiarity increases, difficulties in orientation may be overcome. *(Weisman, 1981)*	Degree of familiarity has powerful influence on wayfinding behaviour. When in a familiar environment disorientation is seldom experienced. Recognition only happens when the environment is somewhat familiar. Familiarity was found to be influential of wayfinding performance.
Fendley, T. (2009)	Information Design Journal	-	Descriptive	-		It is important to refine peoples knowledge of unfamiliar areas, helping them to increase their confidence.
Fuller, G. (2002)	Social Semiotics	-	Descriptive	-		Graphical signage cools down anxiety in an unfamiliar environment.
Hund, A. M. Gill, D. M. (2014)	Journal of Environmental Psychology	Basement	Self Report Field Experiment	62 female & 74 male Students		Familiarity can is considered as a potential covariate.
Ishikawa, T. Nakamura, U. (2011)	Spatial Cognition and Computation	Tokyo	Descriptive Field Experiment	9 female & 11 male Students		Landmark selections is different for familiar and unfamiliar people. Intermediate landmarks help especially unfamiliar wayfinindg navigate with more ease and confidence.
Lawton, C. A. (1996)	Journal of Environmental Psychology	Campus building	Descriptive Field Experiment	174 female & 104 male Students	When familiarity increases waypfinders may often shift strategies *(Bethell-Fox & Shepard, 1988)*	Wayfinders with an orientation strategy can establish his or her position based on previous experience despite being in a relatively unfamiliar area. Wayfinders may switch strategies when gaining familiarity with the environment.

Author & Year	Journal	Setting	Research Type & Method	Sample	Literature	Findings/Discussion
Li, R. Klippel, A. (2012)	Journal of Map and Geography Libraries	Library	Descriptive Field Experiment	8 participants Students		Familiarity is not the only variable that influences wayfinding behaviour. Regardless of familiarity, participant spent the most time where the layout was complex Participant with limited familiarity are more effective in a higher visibility environment. Familiarity and environment weight different on wayfinding performance.
Mottet, M. Eccles, D. W. Saury, J. (2016)	Spatial Cognition and Computation	Outside	Descriptive Course of Action	8 male Students	When individual journey in a familiar environment, their wayfinding will be relatively automatic. In contrast wayfinding in an unfamiliar environments needs more attention and navigational aids. *(Montello, 2005)*	
Soh, B. K. Smith-Jackson, T. L. (2004)	Spatial Cognition and Computation	Forest trail	Descriptive Field Experiment	8 female & 28 male		When unfamiliar in an environment people had difficulties reading and using maps.
Xia, J. Arrowsmith, C. Jackson, M. Cartwright, W. (2008)	Tourism Management	National Park	Descriptive Field Experiment	124 tourists	People respond different depend on the familiarity of the environment *(Allen, 1999)* Partly the level of familiarity of an environment affect wayfinding *((Lynch, 1960; Sorrows & Hirtle, 1999; Weisman, 1981; Winter, Raubal, & Nothegger, 2005)*	Wayfinders partially familiar with the environment are still develop their local cognitive map when travelling. If the way finder is unfamiliar with an environment no cognitive map will have to be generated prior to travel. The type of landmarks used is related to the level of familiarity. Linear landmarks such as pathways were used more often by those tourist who are more familiar with the environment.

TABLE DEGREE OF COMPLEXITY

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Author & Year	Journal	Setting	Research Type & Method	Sample	Literature	Discussion/Findings
Bailenson, J.N. Shum, M.S. Uttal, D.H. (1998)	Journal of Environmental Psychology	Lab	Qualitative Experiment	*First experiment* 18 females & 6 male / *Second experiment* 39 female & 31 male	Complexity impacts wayfinding decisions *(O'Neill, 1992)* / Breaking up the area in smaller regions reduced the working memory *(Sadalla et al., 1980; Downs et al., 1998)*	
Baskaya, A. Wilson, C. Özcan, Y. Z. (2004)	Environment and Behavior	Polyclinic	Quantitative Field experiment	**Experiment 1:** 50 female & 23 male / **Experiment 2:** 40 female & 20 male Students	When familiarity is high, complexity becomes less important *(Bryant, 1982; O'Neill, 1992)* / Complexity of floor plan has greatest influence on wayfinding *(Haq & Zimring, 2003; O'Neill, 1991b)* / Wayfinders rely on clarity and signage in a complex building *(Passini, 1980)* / Signage a decisions points improved wayfinding performance *(Best, 1970)* / Visual access can be hard to achieve in a complex layout, is an important factor *(Lindberg, 1986)* / Symmetrical form is easier for people to understand *(O'Neill, 1991a)*	Polyclinics might be a complex building for wayfinders. / Complex environments might lead to slower development of cognitive maps and therefore causing inaccuracies. / It is suggested to base wayfinding decisions on environmental information that is accessible, helping the wayfinder proceed between decision point to decision point. / In symmetric environments there was an increase in errors when the complexity increased. / When complexity increased, people who were more familiar with the environment had problems wayfinding. / Topological complexity appears to be a variable that can influence wayfinding. / The newcomers can be put in a stressful position if the complexity is high / Symmetrical environments are deficient when use uniformly.

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Butler, D. L. Acquino, A. L. Hissong, A. A. Scott, P. A. (1993)	Human Factors	Basement	Experimental Field experiment	52 Students		People choose the routes which conserved energy regardless of the complexity. Complexity had a weak effect. Complexity might only matter when there is more memory load needed. Complexity undoubtedly affect verbal descriptions and the ability to remember
Chang, H. H. (2015)	Tourism Geographies	Taiwan	Experimental	86 Students		The routes were not too complex and the overall feeling of being lost and errors were relatively low.
Coluccia, E. Louse, G. (2004)	Journal of Environmental Psychology	-	Quantitative Systematic literature review	-	Gender differences might be due to the complexity of the environment *(Lawton et al., 1996)*	Complexity might increase the task and therefore the memory load.
Cope, J. Lutz, J. Ironsmith, M. Elbert, E (1999)	Perceptual and Motor Skills	Library	Experimental Field experiment	328 Students	Complexity of the environment can be defined by the number of choice points *(O'Neill, 1991)* Complex environment now use signs to compensate *(O'Neill, 1991)*	Complexity affect wayfinding behaviour.
Denis, M. Mores, C. Gras, D. Gyselinck, V. Daniel, M. (2014)	Spatial Cognition and Computation	Boulogne-Billiancour, France	Experimental Field experiment	64 Students		Suburbs can be considered complex

Appendix Tables

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Dogu, U. Erkip, F (2000)	Environment and Behavior	Shopping mall	Descriptive Survey	78 female & 76 male Shoppers	A number of studies suggest that complexity is the primary influence on understanding the environment by wayfinding *(O'Neill, 1991)* People navigating in a complex environment relied on spatial properties *(Passini, 1984)*	People find their way through a complex environment by understanding the environment. When the environment gets larger is because increasingly difficult to provide adequate wayfinding with signs and other cues if the environment is ignored. Stress, anxiety and confusion might arise in a complex environment. Hospitals, airports and shopping malls are examples of complex environments. Visual noise is distracting when one is trying to understand the environment. Aesthetic concerns lead to confusing environments
Fuller, G. (2002)	Social Semiotics	-	Descriptive	-		
Lawton, C. A. (1996)	Journal of Environmental Psychology	Campus building	Descriptive Field experiment	174 female & 104 male Students	People navigating in a complex environment relied on spatial properties *(Passini, 1984)*	The environmental cues become a blur when traveling through a complex environment.

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Li, R. Klippel, A. (2012)	Journal of Map and Geography Libraries	Library	Descriptive	8 participants	Complexity of the spatial layout is an important factors *(Lynch, 1960)*	Complexity lead patrons to having trouble finding their way. Size of the environment, number of destinations, intersections and routs are aspects of complexity. A complex layout may lead to poor visibility In low visibility and high complexity the participants spend the most time. With good sense of direction wayfinding performance is better in lower complexity environments. Complexity is related to the connectivity and visibility. Familiarity becomes a major factor when the degree of complexity is low.
			Field experiment	Students		
Lorenz, A. Thierbach, C. Baur, N. Kolbe, T. H. (2013)	Cartography and Geographic Information Science	-	Descriptive	1140 participants	Signage might enhance wayfinding accuracy in a complex environment *(O'Neill, 1991)*	Complexity exerts a strong influence. Added landmarks to a complex map can regarded as not helpful. Complexity made navigating more challenging
			Survey			

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Miller, C. Lewis, D. (2000)	Information Design Journal	Healthcare	Descriptive Literature review Experts Survey	23 experts 885 patients and visitors		Complex site layout made finding the destination difficult Various factors can affect site complexity and people's wayfinding ability, including: • the size and layout of site • the visual accessibility of the site • the architectural differentiation between buildings • the number of site entrances, buildings and building entrances • external building entrances being located on different floors • the number of floors in each building • the number and orientation of circulation routes around the site and the number of intersections (or crossings) of circulation routes • the number and location of prominent land-marks."
Mottet, M. Eccles, D. W. Saury, J. (2016)	Spatial Cognition and Computation	Outside	Descriptive Course of action	8 male Students	Orientation is influence by the complexity *(Eccles et., 2002a; Mottet & Saury, 2013)*	
O'Neill, M. J. (1991)	Environment and Behavior	University	Empirical Field experiment	21 female & 34 male Students	A number of studies suggest that the complexity of the floor is a primary influence on wayfinding. There is a positive relationship between choice points and complexity *(Best, 1970)* Complexity predicted disorientation *(Weisman)* Symmetrical forms are less complex due to their redundant information *(Levi, 1974)*	Signage is commonly employed to compensate the complex environments Raters indicated that symmetry reduces complexity Increase in complexity increased error Increase in complexity decrease in wayfinding performance Signage cannot compensate wayfinding if the complexity is high