REFRESHING THE DESIGN PROCESS:

WEAVING NEUROSCIENCE AND PSYCHOLOGY INTO ARCHITECTURE

A D.ARCH PROJECT SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAIʻI AT MĀNOA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF ARCHITECTURE

MAY 2015

By
Massey Paul Brooks

D.Arch Project Committee:
Ma Ry Kim, Chairperson
David Cicero
Carlos Barrios

Keywords: Architecture, Neuroscience, Psychology, Mirror Neuron, Design

To my family for their unwavering support

Abstract

Architects develop an understanding of many topics that are closely related to architecture, design, and the construction industry. There is a need, however, for architects to be exposed to more information within the fields of psychology and neuroscience. This research finds the gaps in the architectural design process that can benefit from these additional disciplines. It translates, or makes more accessible, relevant topics in psychology and neuroscience. Then, it develops a 'process web' that lays out these topics in an understandable format that shows potential overlaps and opportunities for architects to apply in their design process. In addition to this process web, this research expounds on the topic of mirror neurons. The introduction of this topic offers keys for an architect to understand how a person perceives or experiences comfort, empathy, and understanding within an architectural space. These findings suggest that an architect has the ability to trigger positive responses in the user of a building by applying principles of mirror neuron research by way of their architectural design. The ability to accomplish this can be a very helpful skill for the architect as the goal is always to design and provide the best possible space for those who utilize the architecture.

Table of Contents

List of Figures

Preface

This document has two main goals

1. Make the topics of psychology and neuroscience more accessible to architects
2. Show how an in-depth understanding of a topic in one of these disciplines can wonderfully aid an architect in their process of designing.

A few years ago, I was asked a simple question from a friend of mine: "what do architects actually do?" As odd as it sounded to me at the time and as simple a question as it was, this is the question that has been the cornerstone of discussion amongst those formally trained in the field of architecture as well as those who are simply curious.

The answers I have heard to this question have varied quite a bit. On a practical level, some say that we architects make the drawings that builders turn into architecture. Others say that we invent shelter. It has been suggested that we design all the buildings that people inhabit. On a more abstract level, it has been said that we develop a sense of place for people to call their own. Also that we produce a context for people to exist in, a place to gather or work or sleep or play or study. On a logistical level it is said that we lead and coordinate the process of developing the built environment. That we coordinate all the different disciplines which come together to produce architecture; those monuments of man's production that nearly everyone on earth comes in contact with.

All of these, on some level and to some extent, are absolutely true! But when my friend asked me this simple question, I gave them a simple answer: "We design the *why*." As I saw a perplexed face staring back at me I followed with a question: "Have you ever walked into a building, any building at all, and just stopped in your tracks? Have you ever felt like that building had some sort of effect on you?" "Yeah, of course." was the reply. "Why?" I asked. After a few

moments of silence from my friend, who didn't quite know how to explain their answer, I said "That's what we do; we design the 'why'."

A bit of a bold statement I know, but I believe it nonetheless. Although all the other responses to the question of what we as architects do are very valid, this is my perspective on the subject. We as architects believe to have a unique skill in taking all the different variables of design and weaving them together to produce a beautiful piece of architecture that functions efficiently and at the same time is breathtakingly beautiful. There are so many ways to qualify what is functional and what is beautiful but this is still our goal. Why do some buildings leave us breathless where others leave us simply bored? Why can a space wake us up or lull us to sleep? Why do we sometimes feel motivated just from experiencing walking through a building? Why? These are the questions that we as architects are fiercely passionate about!

And yet, we don't have all the answers; nor is it likely we ever will. Perhaps however, we can get a little closer to answering these questions of why as we continue to reach further into the many topics that surround architecture. I believe there are certain topics and fields of study that can greatly contribute to an architect's ability to answer these questions of why and in turn design buildings with these answers in mind. I believe that as we continue to broaden our perspective and understanding of other disciplines, we as architects will be more capable of making intelligent design solutions that serve the needs of those people who occupy the buildings produced. It is a process.

Chapter 1: Introduction

As architects we strive to design an environment that serves the needs of the people in the most effective and successful way possible. A myriad of different questions, ideas, needs, wants, and opinions go into the design of a piece of architecture, and it is the job of the architect to balance, filter, and combine these different factors in order to solve the problem at hand. These solutions do not come to fruition in a single meeting, but rather a thorough and systematic process is conducted to come to a final design for a project. This has come to be known as the "architectural design process."

This design process can have a wide range of steps and can vary in sequence and intensity depending on the knowledge and ability of the architect and the additional outside factors that press upon the project. Throughout all of this, the goal remains the same: meet the needs of the people who will occupy this piece of architecture.

There has been a growing push in more recent times for the architect to broaden their focus and expertise to topics that are pressing to this day and age. An example and one of the most prevalent topics currently is that of sustainability. There has been a call for architects to place a much greater emphasis on sustainable methods and systems in the architecture that they design. This has been integrated heartily into the design process. The discussion of sustainability includes topics such as passive heating and cooling, resource reclamation, and overall environmental preservation and awareness. All of these different topics have drastically improved the health and environmental impact that these buildings have during construction as well as throughout their life cycle.

These topics are hugely beneficial to the field of architecture and we all have been blessed to be the recipients of such a rigorous integration of sustainable practices into the architect's design process. The buildings that are designed as a result are very sympathetic and even empathetic to the environment that they exist in and to an extent they help to meet the needs of the occupants better such as climate control, cost management, physical health improvement and comfort. All of these are very important topics to be considered during the architectural design process.

One of the main topics that appears to still be neglected however is the emotional health of the occupant; the user. These buildings are sympathetic and even empathetic to the environment but often neglect the need to be sympathetic or empathetic to the occupant. Physical health is more visibly manifested in the occupants of a building, but their emotional health is often more complex and difficult to measure. It is, in turn, much more difficult to consider and understand during the architectural design process. This document is proposing that more attention needs to and can be given to considering the emotional health of the occupant during the architectural design process.

In order to give more attention to this emotional health, we have to understand a person's needs much more thoroughly. There are several disciplines that address this notion of emotional health and the two prevalent disciplines are that of psychology and neuroscience. Neuroscience often deals with the structure and function of the brain while psychology often looks at the resulting behavior of a person. With a more thorough understanding of neuroscience and psychology, we as architects can begin to design architecture that is more sympathetic and empathetic to the needs of the occupant. It is not expected nor am I proposing that the architect should have a deep and extensive knowledge of all the topics related to the fields of psychology and neuroscience but I am suggesting that if these two fields are more accessible to the architect, we can make great progress in accommodating the needs of the users. It is my goal to make these two fields more accessible to the architect and offer

inferences as to how different topics in psychology and neuroscience can be integrated into the architectural design process.

This document intends to look more closely into the architectural design process and determine where the pertinent questions reside, or are lacking, in order to be more attentive to the emotional health of the occupants. Once these facets or possible 'gaps' are found, we will determine how the disciplines of psychology and neuroscience can shed light into how to more effectively meet these needs. The end result will be a document that allows an architect to extract pertinent topics in the fields of psychology and neuroscience, understand their basic functions and qualities, and then integrate them into their design process. This will enable the architect to make more informed decisions that will attend to the emotional needs of the users.

To do this, we will look first at why it is important for the disciplines of architecture, psychology, and neuroscience to have a vested interest in this topic. Then a broad outline of the existing architectural design processes will be introduced and ultimately we will look to see where possible gaps exist into which we can stitch these emotionally sensitive disciplines into. Then we will look at some of the topics in psychology and neuroscience that could be introduced to 'fill the gaps' and bolster the architectural design process. Finally a matrix or web of different concepts within the disciplines of architecture, psychology, and neuroscience will be laid out. Within this web, their possible overlaps will be highlighted and explained, and some suggestions of their usefulness will be addressed. One major topic of mirror neurons will then be discussed more thoroughly and will be used to give examples of how these different disciplines can be woven together.

This complete document will serve as a guide to architects; it will make the topics of psychology and neuroscience more accessible to architects, it will highlight how these disciplines can be integrated into the architectural design process, and it will show examples of this application. As an architect, this

document can be used as a reference manual to help introduce important topics within these two other disciplines and give the framework with which to research further. With the strength of these unique disciplines coming together, we have an opportunity to see an architecture that cares even more and helps even greater.

Chapter 2: Why Should an Architect Care?

In order to fully understand how necessary this topic is, we must first come to a clear understanding as to why we should care about integrating knowledge of psychology and neuroscience into the architectural design process. We will first look at why the architect should hold a vested interest.

There are three overarching principles that drive us as an architect and will ultimately require us to include this knowledge of psychology and neuroscience into our design process. When we have thoroughly understood, agreed, and acted on these principles, we will be able to know with a certainty that we have done everything we can to uphold our commitment as architects. These three principles are responsibility, opportunity, and desire.

Responsibility - "The quality or state of being responsible: as...moral, legal, or mental accountability."[1]

First, we have elected to take on the responsibility of protecting the health, safety, and welfare of the people. This moral, legal, or mental accountability is inherent in our job duties. Before we move forward we must define some of these terms to better understand them.

Health - "Aspects of architecture that promote physical, mental, and social well-being among users or sites and address related environmental concern."[2]

Safety - "Aspects of architecture intended to limit or prevent accidental injury or death among users of the buildings or sites."[3]

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[1] Merriam-Webster. "responsibility." Merriam-Webster. http://www.merriam-webster.com/dictionary/responsibility (accessed May 7, 2014).
[2] "Education Continuing Education System." AIA RSS. http://www.aia.org/education/ces/AIAB089080#P12_864 (accessed May 8, 2014).

Welfare - "Aspects of architecture that engender demonstrably positive emotional and physical responses among, or enable equal access by, users of buildings or sites."[4]

Health and safety focus more heavily on the specific, more measureable details of a building. These two criteria are very important to be understood and followed by the architect, but we will focus more heavily on the topic of welfare. This welfare has a stronger association to the emotional, psychological, and neurological needs within a person or group of people who occupy or inhabit architecture.

With this in mind, we can consider more accurately how we as architects have elected to take on the responsibility to protect the welfare of the people. We hold ourselves morally and ethically accountable for the emotional, psychological, and neurological needs of the people. With the acceptance of this responsibility, we have also elected to more fully understand what those emotional, psychological, and neurological needs actually are. This is precisely what this research document looks to expound upon. We absolutely must understand these details if we intend to uphold our responsibility.

Opportunity - "A favorable juncture of circumstances."[5]

Second, we have the unique and wonderful opportunity to serve these needs on a tremendous scale. Where a variety of professions work with and help a single individual at a time, architects are involved in the development of the environment that every single person occupies. Looking specifically at the educational typology, although not everyone gets a formal education, the ones

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[3] "EducationContinuing Education System." AIA RSS. http://www.aia.org/education/ces/AIAB089080#P12_864 (accessed May 8, 2014).
[4] "EducationContinuing Education System." AIA RSS. http://www.aia.org/education/ces/AIAB089080#P12_864 (accessed May 8, 2014).

[5] Merriam-Webster. "opportunity." Merriam-Webster. http://www.merriam-webster.com/dictionary/opportunity (accessed May 7, 2014).

that do are impacted in a huge way. We as architects have the opportunity to understand the vast needs of the people and meet them in intelligent and innovative ways. This opportunity leads into the final portion.

Desire - " to long or hope for."[6]

Our desire is the final piece of the equation that ensures that the needs of the people are properly met. If we maintain an earnest desire to serve these needs, then we will continually demand of ourselves to learn and more properly understand what those needs truly are. Our desire is the hardest to measure but perhaps the most important to grasp.

With these three categories in mind we can now look more closely into why we as architects ought to care about introducing psychology and neuroscience more precisely into the architectural design process. We will look specifically into the topic of the educational typology here as well.

People are learning in new ways, students are growing in new ways - they have new questions, new needs, and new resources. We must understand that the spaces designed in the past, will not support the current needs. Even if the spaces previously designed were very successful, they will not adequately support the growing and unique needs of those looking to be educated today. The main factor that has changed in a big way is technology. With this massive influx of technology young people are learning in new ways. An infant once learned their alphabet solely from wooden building blocks and now they are learning to tap the screen of an iPad, connecting the letters together. Chalk boards in a high school have been replaced with smart boards and there are projectors and computers in every room. The way that students collaborate and learn and expand their understanding has changed in a huge way due to the technological advancements, but the spaces that they use to do this have remained stagnant. It will take knowledge of the psychology and neurology of a

[6] Merriam-Webster. "desire." Merriam-Webster. http://www.merriam-webster.com/dictionary/desire (accessed May 7, 2014).

person to understand what their needs are in this uniquely different time. It will take a consideration of the neurology of a person to make intelligent design decisions.

The psychology of a person could be explained as the way the emotions and ideas and feelings of a person motivate and drive that person. These factors are not tangible though. We can't recognize them so easily but they are the foundation of how one learns and grows. If we want to meet the needs of the people we cannot simply make sure the ramp is at an adequate grade; we have to understand why we are changing levels in elevation.

Why are you putting someone on a stage? Because a stage can cause something to live; it shows people that there is something bigger going on. Why do we put performances on a stage? Visibility might be one reason but there's something about that delineated portion of space that everyone knows there is something important going on there. On a psychological level we are ready and expecting to see something great happen. We need to understand this.

We, as architects, can facilitate believing. We can help people to believe that they are getting something out of this. We can help a student to believe that there is more to an education than just a desk and a series of tests. There is more to this education thing than just filling in a bubble on a scantron sheet. And we need to know what these students want and what they need. How can we encourage and educate and facilitate growth and discussion and questioning and inspiration and passion and creativity?

We have the opportunity, responsibility, and desire to take care of a person's needs on some of the more fundamental levels in someone's life. We can get to the root of the problem and solution. The root of this all lies in their heart - the innermost part of their mind, the seat of their personal life. We as architects must understand what is in a person's mind because that is where welfare truly exists. This is where that joy and quality of life rests. If we don't understand this, we cannot meet those needs

If we truly want to protect the health safety and welfare of the people, we have to understand what they need in their core. And if we can understand the core of their needs, the way they think, the way they want to discuss and gather and communicate, we can help facilitate that.

When you can get a group of minds together functioning smoothly, communicating clearly, working together, all pistons firing, then great things happen. Sometimes it can happen in a run-down garage that is not responsive to their needs, but much more often a space that is empathetic to the very core of a person can inspire change and growth and movement; the desire to learn.

When people want to be in a space, when it's peaceful, when it's comfortable, when it's uplifting and inspiring, they are inspired and they are willing to inspire others and work together and make big things happen.

We need to understand someone on a personal level, a private, intimate level, to take care of their needs. Yes we want to make sure they don't trip going up the stairs so we keep them uniform in height and depth, but we need to understand more about why this space cares for them.

Why should we care? We care because others care. Because there are others out there that have devoted their entire lives to giving and protecting and caring, and we as architects can care on a monumental level; on a scale that is far beyond one voice.

Chapter 3: Why Should Other Disciplines Care?

Just as it is imperative that an architect is knowledgeable and interested in why we ought to integrate a psychological and neurological approach, a psychologist and a neurologist should have an interest in how the architecture has an impact on their profession and their goals to help and serve the people's needs.

It is important to note here that this chapter focused more heavily on the profession of the psychologist and focuses less on the profession of the neuroscientist. The reason is that this research is going to look more heavily into the work of the neuroscientist in later chapters and the importance of their need to be interested in this topic. With that in mind, neuroscience will be mentioned but the emphasis of this chapter is still indeed on psychology.

A quick note on the topic of neuroscience: there is a growing attention to the field of neuroscience and its integration into the topics of architecture. In the last twenty years there has been a very strong push to understand more of the mind as an architect. For similar reasons that will be discussed about the psychologist, the neuroscientist can greatly benefit from learning more about the needs of the architect and how architecture effects the mind! We will now look more closely into some of these ideas with the example of a psychologist.

It is important to understand what the overarching goals of a psychologist are so that we can understand why it is important for them to have an interest in the topic of architectural process. In *Psychology: The Science of Behaviour*, Michael Passer explains "if we understand the causes of a behaviour and know when the causal factors are present or absent, then we should be able to successfully predict when the behaviour will occur."[7]

[7] Passer, Michael W.. "Psychology: The Science of Behaviour." In *Psychology: frontiers and applications*. 2nd Canadian ed. Toronto: McGraw-Hill Ryerson, 2005. 7.

So what are the goals of a psychologist?

1. to *describe* how people and other animals behave.

2. to *explain* and *understand* the causes of these behaviors.

3. to *predict* how people and animals will behave under certain conditions.

4. to *influence* or *control* behavior through knowledge and control of its causes to enhance human welfare.[8]

With these goals, two questions are presented. Should a psychologist or neuroscientist care about how a space is designed? Should they want to have input into the design process? The answer is a resounding yes to both questions. Not only should they, but it is becoming more clear that they absolutely must! To understand a person, it is necessary to understand the environment that they live in. With a clear knowledge of the deeper influences that the architecture has on a person, a psychologist is then significantly more capable of describing, explaining, predicting, and influencing a person's behavior, ultimately improving their overall welfare. To illustrate this, we will look at two examples of different subsets within the profession of psychology.

The first subset we will look at is that of a practicing clinical psychologist. As defined by the American Psychological Association, "clinical psychologists assess, diagnose, predict, prevent and treat psychopathology, mental disorders and other individual or group problems to improve behavior adjustment, adaptation, personal effectiveness and satisfaction"[9]

The psychologist helps the general welfare of a person who is struggling with any number of challenges in their life. The important factor to note here is that often, the clinical psychologist is working with a person outside of the various

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[8] Passer, Michael W.. "Psychology: The Science of Behaviour." In *Psychology: frontiers and applications*. 2nd Canadian ed. Toronto: McGraw-Hill Ryerson, 2005. 7.
[9] "Public Description of Clinical Psychology." http://www.apa.org. http://www.apa.org/ed/graduate/specialize/clinical.aspx (accessed May 8, 2014).

environments that they are constantly living in. A person usually comes to some form of building or office where that psychologist works, they are helped, and then they go back into the previous environments where the problems originated. They go back home, to work, school, a restaurant, their office building, a high school, a dense city, a rural area, an apartment, a college dormitory, a house, a condo, or any number of other areas.

A clinical psychologist is working with someone outside of the elements and environments that a person is normally in. A psychologist encourages that person and helps them and gives them advice and things to try, maybe medication, and then sends them BACK to all these places. These places might be the problem in the first place. That job might be a challenge because there is something simple like mold, or a space is constricting or claustrophobic, or they are stuck in a cubicle and never interact with anyone. All of these potential factors can be catalysts as to why these psychological challenges originate. If these environments were designed better, with a greater attention to the psychological and neurological needs of a person, a clinical psychologist could be much more successful in treating that person.

This is also why a psychologist should absolutely desire to be included into the architectural design process. If they can help an architect make more intelligent and empathetic decisions during the design process of a piece of architecture, they may be helping to solve the issue at the source. This would in turn be helping a greater number of individuals who would have otherwise struggled with some sort of psychological challenge.

The second example we will look at is that of a researcher in any subset of psychology. These researchers study emotions, felling, ideas, thoughts, the way people communicate, operate in groups, and operate independently. They work to understand why a person does what they do and why they think the way they do. In order to fully understand the way a person thinks and feels, a psychologist needs to be knowledgeable of the environment that that person is in.

If they can understand how the architecture affects someone and understand the ideas that went into this project they can understand how the environment affects them and why people feel the way they feel. People don't just live in a vacuum, they always interact with architecture. Everything they do in a day is at least partially influenced by architecture.

For example, in a workout gym, a person can feel bold, extroverted, and confident or actually feel reluctant, intimidated, and embarrassed. The way that a workout gym is designed can have a profound effect on this. A psychologist may be able to offer the architect invaluable insight into how a person feels when different workout equipment is place next to each other.

A church is another example of possibly conflicting emotions. The general feeling is that of quiet, peace, and tranquility. This is not always how one feels in a church. Sometimes one can feel overwhelmed, crowded, or anxious. A psychologist can help the architect understand why this might be the case but on the same token they need to understand how the existing spaces make someone feel so that they can offer some form of treatment.

They need to know what it is about a space that causes someone comfort or discomfort, joy or pain, fear or motivation, or inspiration. When they want to help people sometimes the solution might be the actual design of the architecture. For example, if someone needs inspiration, a psychologist might encourage that person to go to a space that is inspirational and blesses them. The psychologist needs to know what these spaces are.

A psychologist can and should have a powerful influence in the architectural design process. A more open relationship between the architect and the psychologist can help each profession as well as the built environment make great progress moving forward.

Chapter 4: Architect's Design Process

Now that it is clear how important this discussion is to the field of architecture as well as the field of psychology, we will look into various processes that an architect uses when designing. This will give us an understanding of the different methods available to the architect so we can then determine if there are indeed any missing steps.

In his book *Design in the Built Environment*, R. Frasier Reekie makes the bold statement that

> In the past, the process of designing was vaguely believed to be largely a subconscious activity by 'gifted' individuals - a matter of intuition - which has been described, perhaps accurately, as non-thinking!...But, in more recent times, it has become clear that the problems of the present and the future cannot be grasped much less solved by unreliable and capricious intuition.[10]

This statement, made in the early 1970's, still rings true today and perhaps is even more pertinent now. In a world growing in complexity and detail, the myriad factors that an architect has to contend with and bring together into an intelligent design solution are demanding more attention.

Understanding how this process of designing might be carried out is paramount to the success of this research. We will dive into a handful of different design methods that, put in a sequence, is considered the 'design process.' It is important to note that there are possibly countless different methods and sequences that these methods can be ordered, thus potentially making a huge

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[10] Reekie, Ronald Fraser. "The Design Process." In *Design in the built environment*. New York: Crane, Russak, 1972. 6.

number of design processes. This research intends to group these various processes into larger, more general groups and simplify their factors in order to get to the root of the design process. Once this is clarified we will look into what makes each process unique and ultimately we will delve into one more thoroughly to further this research process.

The first process we will look at is also outlined by Reekie. This is perhaps the most generic of all the different processes we will discuss and also introduces some of the terminology that will be used to explain each subsequent process. Reekie states that "there are many varieties of design procedure, but generally they are rationalisations, in one form or another, of an orderly step by step progression."[11] This progression is made up of four main stages with a final stage wrapping everything together. They are as follows:

Brief - "Clarification and thorough understanding of the design problem by the preparation of the brief statement."

Analysis - "The initial analysis of the problem into parts, that is into sub-problems."

Synthesis - "Free reign is given to the production of actual design in accordance with the essential preliminary steps already taken."

Implementation - "The preparation of the design in its perfected form, and its presentation by drawings, descriptions, models or any other appropriate means."

Communication - "The means, verbal and graphic, whereby concepts and queries are conveyed and discussed between members of the design team."[12]

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[11] Reekie, Ronald Fraser. "The Design Process." In *Design in the built environment*. New York: Crane, Russak, 1972. 8.
[12] Ibid., 7,9.

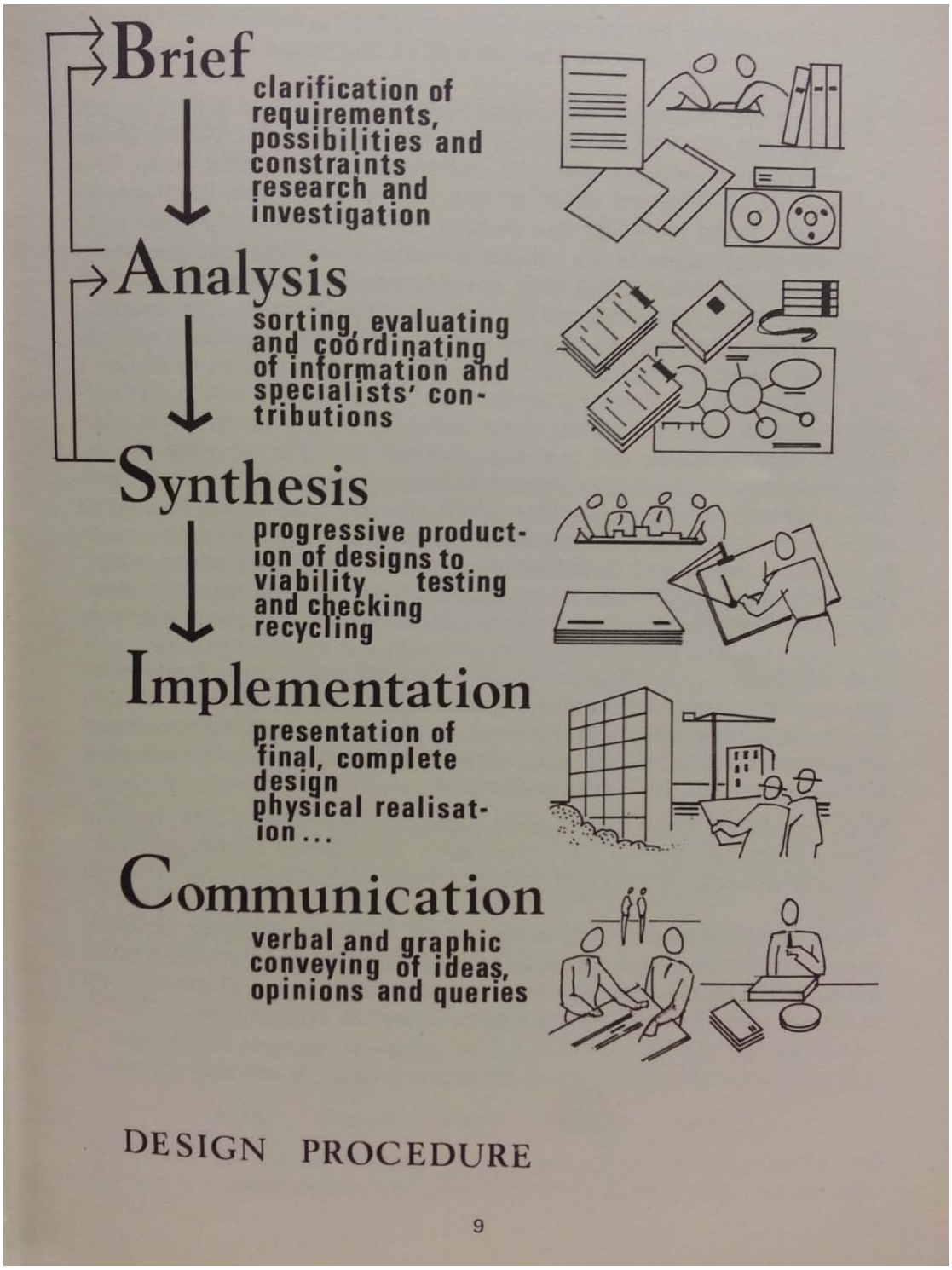

Figure 1: Design Procedure
Source: Reekie, Ronald Fraser. "The Design Process." In *Design in the built environment*. New York: Crane, Russak, 1972. 9.

In figure 1, Reekie explains this information in graphic form, showing how these design stages work together to produce a final design. Figure 2 is a simplification of Reekie's graphics. These diagrams along with the acronym B.A.S.I.C. will accompany each following design process and were developed by Wan Muhammad[13] and have been slightly adjusted again to better maintain clarity and continuity throughout all the different design processes.

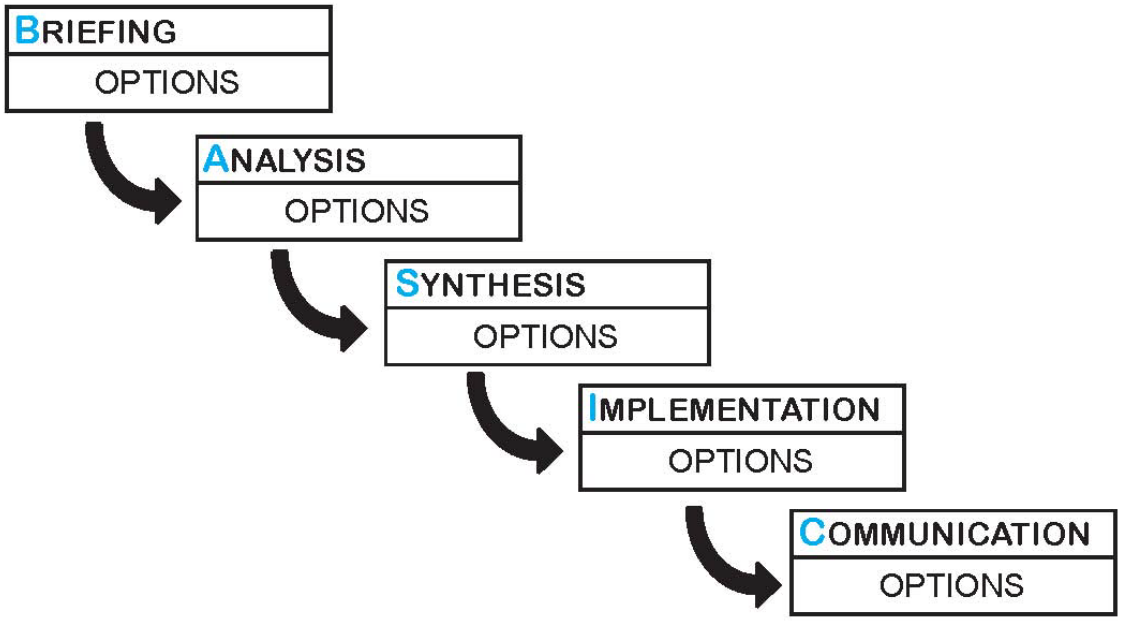

Figure 2: B.A.S.I.C. Design Process

This B.A.S.I.C. process is for the most part a linear process. There can be situations where the process goes back to the initial stages of briefing, analysis, or synthesis but for the general use of this process it is understood to be a very linear process. The benefit of this process is that it is streamlined and can offer a great deal of efficiency in a project. One of the main issues of such an oversimplified process is that of quality. With such a quick and linear process, the risk of a solution being somewhat inadequate in one or all steps of the process is high.

[13] Muhammad, Wan. "Asasku Blog* Delta Edition." : Design Process. N.p., n.d. Web. 8 May 2014. <http://asasku.blogspot.com/2009/03/design-process.html>.

Although there can be many arguments made for or against this linear process it becomes apparent when looking at the following processes that the majority of different approaches to the design process include a somewhat more iterative process.

Another thing to note at this point is that within this process and all of the processes following, the 'A.' and 'S.' in B.A.S.I.C. or the analysis and synthesis portions, are often where the largest room for unique interpretation and individual introduction of each designer's tastes and interests lie. We will look into this phenomenon more closely once the main processes are outlined. For now let's move on to the next process.

The second process we will look at is that of John Christopher Jones.[14] In this process, shown in figure 3, the B.A.S.I.C. process is broken up into three main portions and some intermediary steps are introduced. The brief and analysis steps are grouped together and coupled with a potentially limitless number of "redo's" in order to bolster the initial analysis quality. This is then filtered into a series of options which are then synthesized together and again the redo is introduced. Finally another series of options are produced and eventually one is chosen and then the implementation and communication steps are concluded.

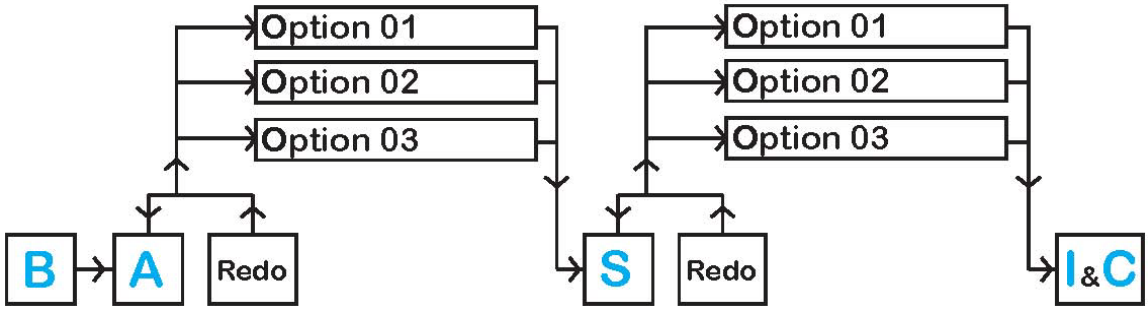

Figure 3: B.A.S.I.C. with Redo

[14] Jones, J. Christopher. *Design methods: seeds of human futures*. London: Wiley-Interscience, 1970. Print.

One of the strongest characteristics of this process is that of the redo step. This step introduces an integral feature that the first process did not have, a decisive need to test and retest an idea. This retesting of an idea is evident in each process following as well.

Another important factor of this process is the use of not only several options, but several sets of options. This ensures that there are various approaches introduced at multiple steps along the design process. The main drawback with this process is that it adds to the timeframe of a project. The multiple iterations begin to stretch out the design process, but often times the reward is worth the time invested.

The third process we will look at is that of Bryan Lawson.[15] Lawson explains that the different stages within a design process, although given separate titles, often function and are developed simultaneously. Figure 4 highlights how the bulk of the different processes operate within a single stage and are all very closely linked.

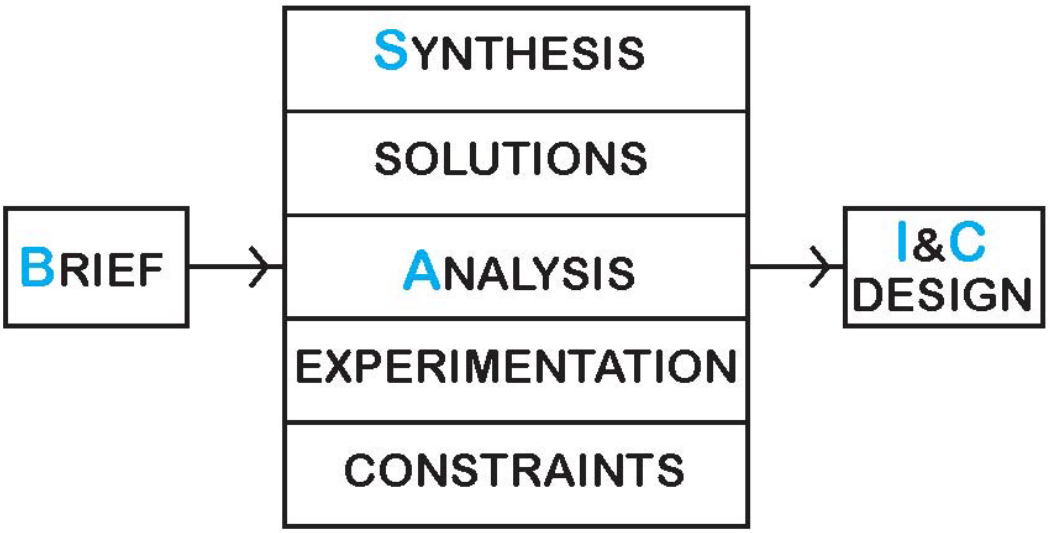

Figure 4: B.A.S.I.C. Vertical

[15] Lawson, Bryan. "3 Route maps of the design process." *How designers think: the design process demystified*. Completely rev. 3rd ed. Oxford: Architectural Press, 1997. 33. Print.

Lawson explains this further when he states that "it seems more likely that design is a process in which problem and solution emerge together. Often the problem may not even be fully understood without some acceptable solution to illustrate it."[16] This enforces the notion that the design process is not only difficult to map, but may be impossible to fully explain it in a single diagram or explanation.

This method is successful in that it is likely the standard example of how most processes actually function. Although it may not always be the intention, if there is not a clear decision by architects to hold themselves to a more rigorous process, they will likely revert to moving back and forth between all of these stages. Without a great deal of attention to their process, architects might find themselves designing in this manner. That is not to say this is a negative, simply that it is not always deliberate. The benefit to this type of process is that there is a great deal of flexibility and instinct by the architect. The majority of the decisions are made simultaneously and all have a visible impact on each other. An architect that can maintain a clear picture of all the disparate parts might find this process to serve them very well.

The fourth process we will look at is that of James C. Snyder.[17] This process appears to have the greatest deal of structure and sequence while simultaneously promoting a cyclic process and a series of iterations. The first diagram, figure 5, shows the more rigid structure of the process. The steps progress through the B.A.S.I. stages and then there is the option to either complete to the C. stage or go back and adjust the design.

The next diagram, figure 6, show how this process can then take on a very fluid and cyclical state. Snyder expounds that:

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[16] Lawson, Bryan. "3 Route maps of the design process." *How designers think: the design process demystified*. Completely rev. 3rd ed. Oxford: Architectural Press, 1997. 47. Print.
[17] Snyder, James C., and Anthony James Catanese. "Design and the Design Process." *Introduction to architecture*. New York: McGraw-Hill, 1979. 159. Print.

> ...a designer may run through the sequence quickly at the advent of a project to generate a range of preliminary or limited proposals. This, in turn, may help to focus programming activities such as the identification of appropriate information needs or client reactions.[18]

Each iteration can then be placed back into the original sequence of stages and tested again in order to meet the specific needs that the project requires. This system of maintaining a clear sequence of stages and then going back again and again appears to have a very successful concept of checks and balances. Within each initial sequence there is room for instinct and flexibility but it always has the opportunity to be run through the sequence again to adjust and improve upon the original idea.

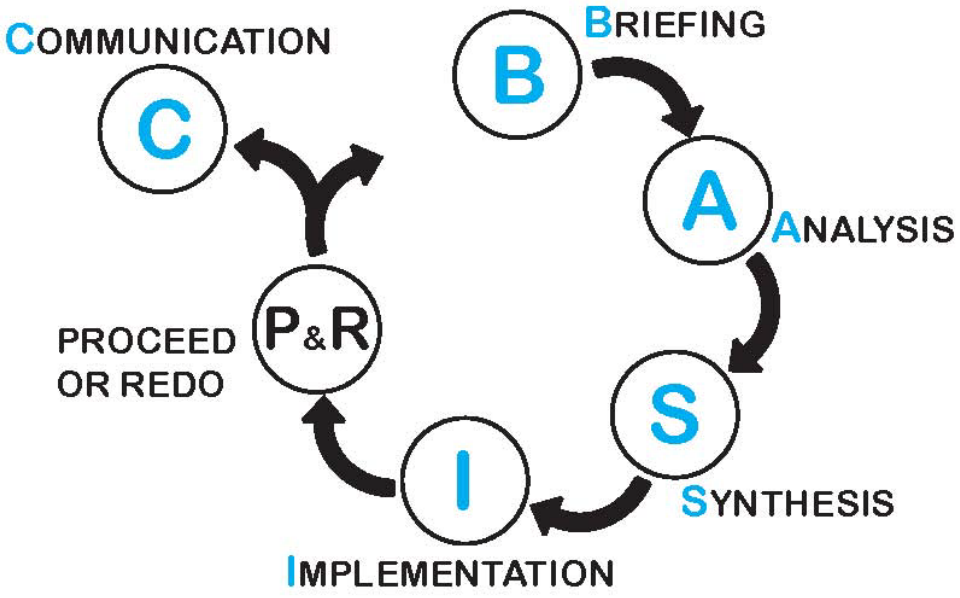

Figure 5: B.A.S.I.C. Circular

[18] Snyder, James C., and Anthony James Catanese. "Design and the Design Process." *Introduction to architecture*. New York: McGraw-Hill, 1979. 159. Print.

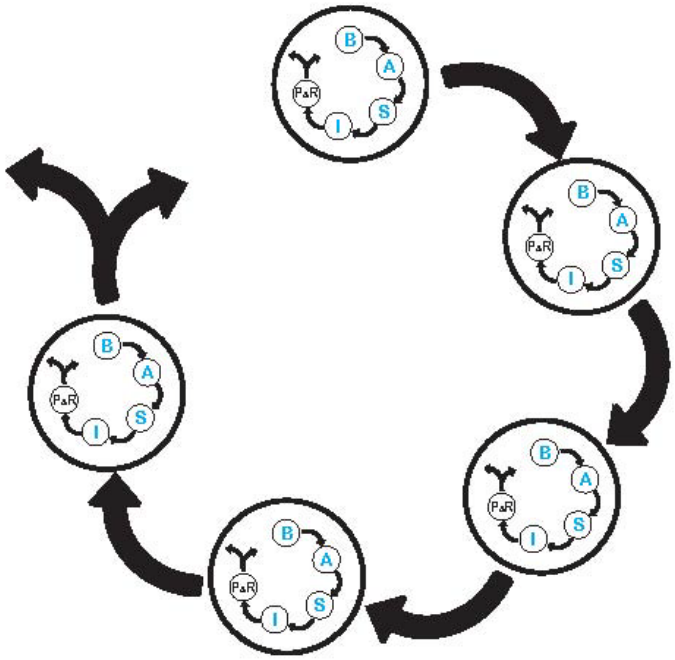

Figure 6: B.A.S.I.C. Circular Series

This process can also have some drawbacks, primarily with the amount of time it may take to complete it. Taking each iteration through the sequence possible several times can drastically lengthen the time investment. Also, there may also be a struggle to decide on all the proper solutions with so many different options being discussed.

The fifth and final process we will look at is that of Yehuda E. Kalay.[19] This process highlights the notion that after each step there are going to be a number of options or variables with which to choose from. Then once a choice is made, there are again multiple options or variables to once again select. These steps of making a selection, finding the options, and making another selection are the basis of this process, highlighted in figure 7.

[19] Kalay, Yehuda E.. "Redefining the role of computers in architecture: from drafting/modelling tools to knowledge-based design assistants." Computer-Aided Design 17.7 (1985): 319-328. Print.

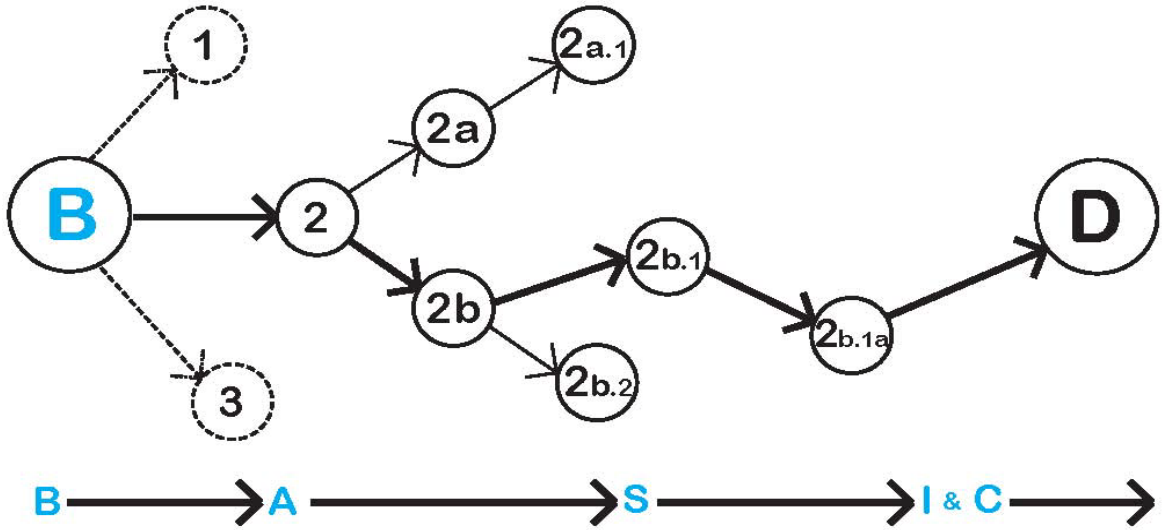

Figure 7: B.A.S.I.C. Variable Tree

This process looks to be very helpful when there are a number of consultants, as well as the client, all making input in the beginning stages of the design process all at once. Each time a decision is made, different input is made by each party adding to the new options to be selected. This is, of course, not the only way in which this process can be influenced but it definitely supports this method well.

This process is good in that it makes it convenient for multiple voices to come into the discussion during each stage of the design process. This could possibly offer a great deal of clarity and understanding for the architect and result in a more thoughtful design. However, this process could also become very difficult to maintain the progress as well as keep the main goals of the project in mind. There is a possibility that all these different voices could cause confusion and halt the progression of the design. It would be imperative that whoever was in charge of directing a process like this forward would be able to regulate and filter all of these different factors and still come out with a unified design solution for the project.

Although this by no means could be considered a fully comprehensive outline of all design processes, these five different approaches encompass a strong overview of the different ways an architect can approach design. With all of this in mind, this document will dive more deeply into one of these processes in order to engage a greater focus to the overall research.

Though each design process could be used in order to further this research, we will look more closely at the fourth process discussed, the cyclical approach outlined by James C. Snyder. This process offers the most effective organization of steps to facilitate the introduction of psychology and neuroscience into the architectural design process. With its format of multiple quick iterations, this cyclical approach will allow us to test each integration of these outside disciplines quickly. Then with the sequence of testing each decision again through all the stages, we can come to a clear understanding of whether or not the layering of disciplines was successful.

Chapter 5: Finding the Gaps

Now that we have concluded the most relevant type of architectural design process, we will break it down to its component parts to understand where the potential gaps of understanding might lie. Within this design process there is a need to integrate questions, answers, knowledge, ideas or goals from psychology and/or neuroscience in order to develop a more useful and effective design process.

There are several possible areas where this integration could occur, but we will delve into one specific section in order to maintain a clear focus of this research and to conduct the necessary tests to verify that this is indeed the right choice. We will now break down the design process into smaller categories and ultimately come to a single area within a sub-category where we will integrate the knowledge from psychology and neuroscience.

Looking again at the overall group of the design process, we have established five categories: B.A.S.I.C. Briefing, Analysis, Synthesis, Implementation, and Communication. Figure 8 illustrates this breakdown. Briefing often stands on its own because it is simply a step of collecting the facts and there is no real input or deciphering to be done by the architect. Analysis and Synthesis can be grouped together due to the similarities in their need for the architect to interpret and apply their input and knowledge on the subject. They also make up the main portion of the design process. Implementation and Communication can also be grouped together because by this point the design decision has been established, and it is a more technical process of simply carrying out the decisions already concluded. They can absolutely require more thoughtful consideration and design decisions but often if that is the case the process is brought back to the Analysis and Synthesis portion.

It is apparent that the main drivers of the design process often are evidenced within the Analysis and Synthesis steps. Although the types of topics and questions that psychologists and neuroscientists might introduce can likely be integrated in either step, there is a greater demand for these topics to be integrated at the Analysis stage. The Synthesis stage is more heavily focused on actually grafting these different solutions and coming to a design solution. Thus, we will look more closely at the Analysis stage to see where these different viewpoints from psychology and neuroscience might be woven.

As much of the design process is a series of asking the right questions that help an architect come to an appropriate solution, we will look at some of the more common questions that an architect asks during this step. We will then be able to highlight where the topics of psychology and neuroscience can be asked with the usefulness.

The questions asked within the Analysis stage range from topics of how the building will enhance the vision of the project to how it will meet different building codes. As seen in figure 8, the main topics have been categorized into Vision, Brand, Client, User, Precedent, Site, Building, Interior, Sustainability, Cost, Program, and Material. Within these different categories the obvious selection to delve deeper into is that of the User. We are interested in the emotional needs of the user.

Within this category, there are six main categories that we need to know about the user. They are Number of Users, Demographics, Customer Journey, Lifestyle, Brand Communication, and General Needs. Of these six categories, there are three that deal very closely with the user's needs. Customer Journey deals with the *order* of needs, Lifestyle deals with *quality* of needs, and General Needs deals with *quantity* of needs. Although all three could potentially discuss the user's emotional needs, the quality of needs is the most closely linked with this discussion. This category of Lifestyle will be the area where the disciplines of psychology and neuroscience will be integrated in the process of this research.

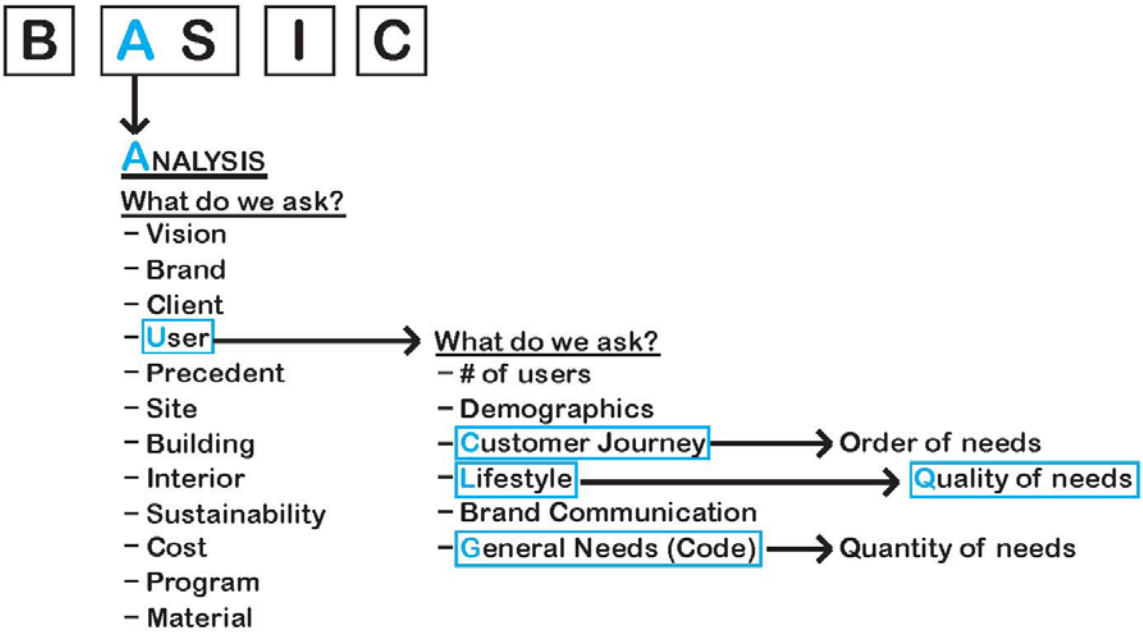

Figure 8: Analysis Breakdown

We have now determined the specific gap in which we ought to integrate the topics of psychology and neuroscience. This integration will be the development of a new or refreshed architectural design process. In the next chapter we will discuss the criteria for selecting different themes in either psychology or neuroscience and how they can be integrated into the architectural design process.

Now that we have determined the gap in the architectural design process, we will look to fill it. Ultimately this will be accomplished through a Process Web (Figure 9) that I have designed which will be explained more thoroughly in chapter eight. The purpose of this process web is to show an architect some of the more relevant topics within the fields of psychology and neuroscience, explain their relevance and possible applications, and show how each topic could be researched further. Each topic has an importance in the architectural design process but each architect can determine which topics hold the greatest importance to them. One of the most compelling topics that is highlighted in that

process web is that of mirror neurons. Before we look at the complete process web that has been developed, we will look at this interesting topic of mirror neurons and their application in the architectural design process.

Figure 9: Process Web

Chapter 6: Mirror Neurons

Finally we have made it to the portion of the document that gives a more thorough account of one of these topics discussed in the process web: mirror neurons! We will look at the history of mirror neurons and what they are, how the knowledge is being applied today and finally we will look at possible architectural application. The goal of this section is to highlight the very unique topic of mirror neurons and show how relevant they are to architectural designers today. After reading through this, the expectation is that you have enough knowledge of this topic to begin to apply its principles in your design process right away. As with all research the goal is practical application and with a clear understanding of the usefulness of mirror neurons we should be able to take action! This proposal is my unique, innovative solution through the lens of an architect. Although the scientific community may not currently support these ideas, it is my choice to form this as the basis of my proposal. The scientific evidence is still being developed and I'm proposing this unique perspective of how we could move forward with this new perspective.

This chapter relies heavily on the initial research and findings of a group of researchers in Parma, Italy in the mid 1980's and into the 1990's. This group, consisting of Giacomo Rizzolatti, Vittorio Gallese, Luciano Fadiga, and Leo Fogassi has been credited with the discovery of mirror neurons. As this research has been discussed over the last twenty years, one book has added a great deal to the conversation. "Mirroring People" by Iacoboni[20] brings a great deal of ideas to the table and will be referenced for a large portion of the following discussion of what mirror neurons are and their possible applications. One main source that

[20] Iacoboni, Marco. *Mirroring People: The New Science of How We Connect with Others*. New York: Farrar, Straus and Giroux, 2008.

challenges the fame of mirror neurons is "The Myth of Mirror Neurons" by Gregory Hickok[21]. This book brings to light some quality counterarguments to some of the grandeur of mirror neurons. Although there are other resources that have begun to circulate, these works highlight the main points that I will be addressing and will help us to understand the usefulness of mirror neurons, especially in their application to the architectural design process. I first came to know about mirror neurons from "Architecture and Neuroscience" by Pallasmaa, Mallgrave, and Arbib.[22] It's heavy focus on the philosophy of art and architecture causes it to not have the same necessity for my research but it was the catalyst that got this entire investigation started.

6.1: What is a neuron?

Before we dive into the discussion of mirror neurons specifically, it is important to first define what a neuron is. "Functional Neuroscience" written by Gazzaniga, Steen, and Volpe helps to clarify this precise cell located in the human body. A neuron is a type of nerve cell commonly found in the central nervous system. The main purpose for a neuron, as opposed to nonneural nerve cells, is its usefulness in communication. "Being a cell specialized for communication, a neuron is capable of emitting an electrical impulse. Whereas a nonneural cell, when stimulated, simply accepts the charge passively, a neuron responds dynamically."[23] These neurons are responsible for a large amount of the sensing, communication, and reaction of outside stimuli acting on the human body.

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[21] Hickok, Gregory. *The Myth of Mirror Neurons: The Real Neuroscience of Communication and Cognition*. New York: W. W. Norton and Company, 2014.

[22] Pallasmaa, Juhani, and Harry Francis Mallgrave. *Architecture and Neuroscience*. Espoo, Finland: Tapio Wirkkala-Rut Bryk Foundation, 2013.

[23] Gazzaniga, Michael S., and Diana Steen. "Neurons: The Essential Physical Elements for Behavior." In *Functional Neuroscience*, 17. New York: Harper & Row, 1979.

There are three main types of neurons found in the human body, as highlighted in the previous chapter; they are sensory neurons, motor neurons, and interneurons. A sensory neuron is "a neuron that transmits nerve impulses from a sense organ towards the central nervous system"[24] These neurons receive information from an outside stimulus and begin the process of relaying that information back to the brain. An interneuron is "a neuron that conveys impulses from one neuron to another."[25] After the sensory neuron receives the information, the interneuron transfers that information to the brain. The interneuron could be thought of as the messenger neuron. Finally, once the brain has processed this information and decided its reaction, it transfers that information, via the interneuron again, to the motor neuron. A motor neuron is "a neuron that passes from the central nervous system or a ganglion toward or to a muscle and conducts an impulse that causes movement."[26] This motor neuron activates the actions that our bodies perform. Working in conjunction, these different neurons collect and communicate information for our minds and bodies to process and utilize.

The important part of these neurons is that they are the catalyst for action. Neurons, especially the motor neurons, cause us to move and act in any given circumstance. If we intend to move our arm and grasp a remote control or a cell phone, the neurons fire and send the necessary information to the muscles. If we intend to walk forward and kick a soccer ball, the necessary neurons fire yet again. If we want to put a hat on our heads, you guessed it; those neurons fire and transfer the important information to the muscles in our bodies to perform such an action. The results are precise and efficient!

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[24] Merriam-Webster. "sensory neuron." Merriam-Webster. http://www.merriam-webster.com/dictionary/sensory neuron. (accessed Feb 10, 2015).
[25] Merriam-Webster. "interneuron." Merriam-Webster. http://www.merriam-webster.com/dictionary/interneuron. (accessed Feb 10, 2015).
[26] Merriam-Webster. "motor neuron." Merriam-Webster. http://www.merriam-webster.com/dictionary/motor neuron. (accessed Feb 10, 2015).

If we look a little more closely at the group of motor neurons, we will see some interesting information. These neurons almost always fire *only* when a desired action is going to take place. What I mean by this is these neurons fire and as a direct result, the action or movement occurs. Also, these motor neurons only fire with specific information from the brain, which is often (if not nearly always) a direct result of the information brought in by the sensory neurons. Thus, it is almost always a linear process; sensory neurons receive information, interneruons transfer this information to the brain, the brain deduces the necessary action to take, interneurons then transfer this information to the motor neuron, and the motor neuron tells the muscles how to move and operate. This is the process and there is rarely a deviation from these steps. Within this process there is always an intentional goal; there is a need to move or function and the brain tells the body to do just such a function, and the body does it. Simple. However, there is one type of neuron, often considered to be in the subset of a motor neuron, which happens to operate a little differently. This is the mirror neuron.

6.2: What is a mirror neuron?

Now that we are on the topic of mirror neurons; lets address what they are and what they do. Mirror neurons are a unique type of neuron, which in their simplest explanation cause us to mirror or mimic another's actions. Now this is often a subconscious decision to mirror and is not always manifested physically but the truth remains that mirror neurons, as their name suggests, causes us to mirror other people. And perhaps we, via mirror neurons, might also mirror other things, not just people? We'll look into this in a bit but first we need to understand a little more about what mirror neurons are and specifically how they operate.

As previously stated, there is a growing amount of information that has been developed on this topic in the last twenty to thirty years. Much of it,

however, is very dense and communicated through the lens of brilliant neuroscientists who speak and write with the complex jargon of their discipline. There is one seminal text that looks to simplify the complexities that go into neuroscience and explain mirror neurons in a more digestible manner. Marco Iacoboni, in his book "Mirroring People," makes great leaps forward in explaining this complicated topic and his work will be referenced quite a bit in the following text. As we look through this information, we will certainly see some possible flaws in logic but the foundation of the information presented is wonderfully useful as we begin to discuss how this knowledge of mirror neurons can assist us as architects.

First, here is a brief history of the discovery of mirror neurons. Affectionately dubbed the "Fab Four"[27] by Iacoboni, four researchers at the University of Parma in Italy have been credited with the discovery of mirror neurons in the 1980s and 1990s. This group consisted of Giacomo Rizzolatti, Vittorio Gallese, Luciano Fadiga, and Leo Fogassi. These four men each contributed a unique ability and expertise that was likely a big help in this discovery of mirror neurons. Rizzolatti, the lab manager and considered to be the leader of the group, "...should be considered as nothing less than a Renaissance man."[28] His expertise and interest in a wide variety of topics allowed him to think critically yet uniquely about the problems he was presented with. Gallese, a neurophysiologist, held the strongest interest in the philosophical realm. Gallese seemed interested in "...finding the appropriate analogies between philosophy and neuroscience, explaining the group's discoveries in less scientific and more philosophical terms." This interest in merging disciplines together is precisely what this paper intends to do, only merging the architecture, neuroscience, and psychology fields instead. The team saw great strength in having skill sets in various disciplines. Fadiga had a skill in running a successful lab and working with people. Fogassi was a talented and capable lab technician. These four men

[27] Iacoboni, Marco. *Mirroring People: The New Science of How We Connect with Others*, 21. New York: Farrar, Straus and Giroux, 2008.
[28] Ibid., 20.

had the necessary abilities and were willing to challenge the paradigms of the time. This seems to be a big reason as to why and how this discovery of mirror neurons was made.

So what exactly did they find? They found a class of nerve cells that would make scientists and others reconsider how we think about interaction, action, mimicry, and decision making. Some of the ideas put forth on the usefulness of mirror neurons may be a bit far reaching, so it is important we take all of this information with a grain of salt. But if even a fraction of the revelations made by the discovery of mirror neurons are relevant, then we are set up for great success as architects.

6.3: The functions of a mirror neuron

First we will look at how mirror neurons function. Simply put, mirror neurons can fire either when a person sees, feel, hears, or possibly even smells or tastes something. The idea is this: if I watch you reach for an apple on a table, my mind mimics the same actions subconsciously. These mirror neurons perceive the action that is about to happen and begin transferring information to and from the brain in an attempt to carry out the very same action that we see in front of us. Other functions in our minds override these impulses in most situations so there is not actually a resulting action. Why do we do this? Some theories include that it is the basis of how we empathize with people, how we anticipate action for a proper reaction, and how we perceive the goals of each activity. Often it is considered that these functions in our brain help us to understand the situation more fully by actually 'acting it out' in our minds. In so many situations in life, the best way to know something is to know it experientially and not simply be able to grasp the concept. This experiential knowledge is paramount in our lives.

In order to get more clear on how these mirror neurons function, I'll explain an experiment conducted by the researchers in Parma and I will also include some information from Iacoboni[29] concerning the same topic. The researchers began conducting experiments on a specific type of monkey, a macaque monkey. They were used because of their similar brain organization to the human, thus linking the relevance of their research as closely as possible to the usefulness of the human mind. "...Rizzolatti and his colleagues implanted electrodes in area F5 of the macaque subjects and recorded any electrical changes, or "action potentials," on the surface of individual neurons as the monkeys performed certain tasks in exchange for rewards of food."[30] This allowed them to monitor the neural activity in the monkeys' brains as they performed these tasks. There were a great number of different experiments held by the researchers in Parma but we will look quickly at one of them to illustrate the function of the mirror neurons.

The Parma team conducted a number of "grasping" exercises with the monkeys. They would place a teacup, a raisin, an apple, etc. in front of the monkeys. In some cases the monkeys would just observe the experimenter grabbing the item and bringing it to their mouth or giving it to another monkey. In other cases, the monkey would actually grasp the items and either bring it to their mouth or give it to another monkey. The main findings of this are really the topic of discussion here. What the researchers found is that these mirror neurons fired at interesting times and under unique circumstances. As a researcher grasped a raisin, there was neural activity (mirror neurons) in the monkey's brain that simulated the exact same grasping motion. What was even more interesting is that there was not a strict correlation to which hand was being used, but there *was* a correlation with the type of grasp being used. The grasping of a raisin requires a precision grasp with the use of the thumb and forefinger only. The

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[29] Iacoboni, Marco. *Mirroring People: The New Science of How We Connect with Others*, 21-27. New York: Farrar, Straus and Giroux, 2008.
[30] Iacoboni, Marco. *Mirroring People: The New Science of How We Connect with Others*, 22. New York: Farrar, Straus and Giroux, 2008.

grasping of an apple requires a whole-hand grip. Only specific neurons would fire which would signal the specific type of grasp necessary to conduct the same action that the monkeys observed.

Some of the mirror responses were stimulated by visual provocation while others were stimulated by physical interaction. There also seemed to be a tight correlation between action and perception.

> These cells are called strictly congruent mirror neurons because they fire for identical actions, either performed or observed. For instance, a strictly congruent mirror neuron fires when the monkey grasps with a precision grip and when the monkey sees somebody else rasping with a precision grip.[31]

This type of mirror neuron, the strictly congruent mirror neuron, is not the only type. There is also a group of mirror neurons that have a looser relationship and are called broadly congruent mirror neurons which

> "...fire at the sight of an action that is not necessarily identical to the executed action but achieves a similar goal. For instance, a broadly congruent mirror neuron may fire when the monkey is grasping food with the hand and then the monkey is seeing somebody else getting food with the mouth."[32]

Either way, the goal in the mind of the monkey is likely the same: consumption. If the monkey can perceive the goal, the mirror neurons will fire in direct response to this. The idea of mirror neurons helping to anticipate goals will be discussed more when we look at the general uses of mirror neurons.

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[31] Iacoboni, Marco. *Mirroring People: The New Science of How We Connect with Others*, 25. New York: Farrar, Straus and Giroux, 2008.
[32] Ibid.

Another experiment conducted in the labs in Parma concerned the idea of performed actions and observed actions. This time, a screen was placed in front of the object which would obstruct the view of the object from the monkey, and then experimenter's hand moved behind the screen and grasped the object. The monkey's mirror neurons still fired. This suggests that the mirror neurons are indeed influenced by past experience or prior knowledge.

As elegantly stated by Iacoboni, "Is this sufficient evidence for us to conclude that mirror neurons code the intentions of the person grasping the object? Probably not..."[33] But what it does suggest is that these mirror neurons at least play a critical role in this process. A number of additional experiments after this time helped the researchers conclude, "Mirror neurons let us understand the intentions of other people."[34] Similarly, can mirror neurons help us understand the use and function of architecture? We'll look into that question as we consider the specific uses of mirror neurons.

6.4: General uses of mirror neurons

Now that we have a better understanding of how mirror neurons function, we can look at some of the broad uses of mirror neurons. The main topics we will look at are *empathy, understanding, imitation,* and *intention*. It is important to remember at this point that mirror neurons are not solely responsible for the function or development of these topics but are relevant in certain ways. Iacoboni explains that mirror neurons are linked to the way we operate both mentally and emotionally.

[33] Iacoboni, Marco. *Mirroring People: The New Science of How We Connect with Others*, 29. New York: Farrar, Straus and Giroux, 2008.
[34] Ibid., 34.

> We achieve our very subtle understanding of other people thanks to certain collections of special cells in the brain called mirror neurons. These are the tiny miracles that get us through the day. They are at the heart of how we navigate through our lives. They bind us with each other, mentally and emotionally.[35]

I also support the notion that mirror neurons have a stake in the way we operate and learn and understand, but I believe that they operate within the realm of many other factors. The importance of them, however, is that they do seem to lie in the crossroads of many of the different internal, subconscious factors that make up a person's perspective on space and the people and environment that surrounds them. This fact alone should have a very strong impact on us as architectural designers and the way we understand how people perceive space.

Now that it is clear that mirror neurons have a voice in this conversation, we can look at some of these topics and how mirror neurons have an effect on a person. Mirror neurons are, in part, responsible for the way that we *empathize*. When someone is excited, we can actually feel that excitement. When we perceive all the things that are evidenced by one who is excited: the large smile, the increased breathing, the faster hand and body motions, etc., the mirror neurons in our mind fire and cause us to experience these emotions. When we watch a movie, we can feel the emotion that they are feeling; our hearts beat faster, our palms sweat. We can also recognize these emotions and, based on our past experiences, deduce that they are happy; we remember a time when we felt the same way, and then those same endorphins can flush though our body. The difference between recalling these emotions and deducing their effect and experiencing them due the mirror neurons as we watch someone else experience them is the speed and magnitude that the mirror neurons produce

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[35] Iacoboni, Marco. *Mirroring People: The New Science of How We Connect with Others*, 4. New York: Farrar, Straus and Giroux, 2008.

these emotions. The mirror neurons react almost instantly and do not require our conscious mind to interpret these emotions. Additionally, instead of reminiscing over a memory that may be hazy or faded, the mirror neurons actually replicate feelings in the brain in real time. There are a number of other factors that go into a person experiencing empathy but these mirror neurons may be the catalyst of the whole operation.

Another topic that mirror neurons have a hand in is that of how we *understand*. One of the experiments conducted back in Parma dealt with the ideas of action and perception in people and questioned whether they could possibly be linked. Basically what happened was whether a person saw someone else picking up an apple or just saw an apple sitting on a table, they developed the motor plans that would ultimately cause them to grab the apple. "In short, the grasping actions and the motor plans necessary to obtain and eat a piece of fruit are inherently linked to our very *understanding* of the fruit."[36]

This ability to understand what an object *is* also comes with the ability to understand what it *is used for*. It is nearly impossible to consider what a car is comprised of (engine, wheels, chassis, seats, etc.) without also considering what it is used for (to drive, to translate from one location to the next). Our mirror neurons hold a part in how we understand the use and function of an item. This must hold true in the field of architecture as well. When a person sees a door with a doorknob or handle, they already also inherently understand what that door is used for. The most important thing here is that they know without a relatively lengthy process of interpreting and deducing consciously. It has already been determined by the help of mirror neurons. This idea that we can deduce things subconsciously and rapidly will be important when we discuss the architectural application of mirror neurons in the next section.

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[36] Iacoboni, Marco. *Mirroring People: The New Science of How We Connect with Others*, 14. New York: Farrar, Straus and Giroux, 2008.

In addition to empathy and understanding, the concept of *imitation* is also an important topic in the discussion of mirror neurons. It has already been established that mirror neurons look to interpret the outcome of a particular action that a person perceives. The mirror neuron already activates the function of imitation within the mind, though often the physical action is not manifested because our mind overrides the action. Also, it is not always necessary for us to imitate another's actions. However, there are times when it can be very useful, such as in a developing child or when we are attempting to relate to another person.

As a child develops, they are constantly mimicking the people around them. They watch a parent changing channels on the television with a remote, then they find their own remote and do the same. One baby picks up a blanket, and the baby watching them finds a blanket to pick up. Most of what a child learns as they develop is grounded in pure imitation. Mirror neurons aid a child in this process.

We have seen that in the experiments with monkeys, they performed actions that they had not performed before. This was the "...first evidence of mirror neurons that prefer actions that are *not* in the motor repertoire on the observing animal"[37] This suggests that a monkey's mirror neurons were firing even if the monkey had never performed that specific motor function before. This may be the base evidence to conclude that mirror neurons can have a profound effect on the way a person develops and imitates.

The other aspect of imitation that we should consider is how people attempt to relate with another person. Here is an example that I notice and test on almost a daily basis. When standing and conversing with someone, I'll shift my weight from one leg to the other and a few moments later the other person

[37] Iacoboni, Marco. *Mirroring People: The New Science of How We Connect with Others*, 41. New York: Farrar, Straus and Giroux, 2008.

shifts their weight as well. I cross my arms and a little later I notice that their arms are in some way also crossing their body. When I open up my posture and relax, like clockwork they are mimicking my actions. This doesn't happen every single time but it happens with enough frequency that I have begun to really notice it and I now pay attention to see if I do it as well, and I do! The most amazing part of all this is that it is almost always unintentional. We are subconsciously recognizing a change in the personal or physical state of someone else and we are adjusting our own to accommodate.

Where this can be important in the realm of relating to people is that we often want to match a person's energy level, openness, extroversion, and overall personality. If they are reserved we often cannot communicate well with them if we are yelling and being boisterous. Similarly, if they seem to be tucked to themselves, with arms crossed and shoulders shrugged, we realize that they feel crowded and we change our stance to accommodate. We long to relate to people and one of the main ways we do this is by matching body language. This is a large part of the topic of non-verbal communication in the discipline of psychology as well.

Ultimately, this topic can be helpful to architects as we understand how an architectural space affects or could possibly respond to the body language or level of introversion or extroversion of others. Mirror neurons clearly hold a role in the art of imitation. Whether it is a developing child or a fully mature adult, imitation is a habit that we all possess - often on a subconscious level. The role of mirror neurons becomes clear in the process of imitation as we are already primed to take action due to the function and application of mirror neuron operation within our minds.

Finally, we will look at the topic of *intention* within the context of the use of mirror neurons. As we have already seen, mirror neurons are interested in the intention of a person's actions, whether it is grasping a teacup or eating an apple.

When we see these objects and consider them in the context of action, we are anticipating the intention. When someone grabs a pen, there are several possible intentions: they could begin tapping the pen on the table to produce a beat, or they could use it to write something down. We almost always expect that the intention is to write. What about with a cell phone? Someone could be making a phone call, sending a text, taking a photograph, or any other number of functions. The intention is more difficult to expect but we are still interested in the intended action.

Under the subheading "Do as I say, not as I do"[38] Iacoboni indicates that mirror neurons are often more focused on the goal of an action and much less interested in the motor functions themselves. He goes on to state that "...these neurons seem to be the ideal brain cell to implement this form of imitation rooted in imitating goals."[39] We are always interested in the goal and the result of a situation. It may be true that mirror neurons are a helping force as we actually anticipate and expect certain goals to occur. This will also be a topic discussed in the next section.

These different topics of the uses of mirror neurons are only some of the possible applications that exist today. It is now necessary for us to get a bit more specific, especially as it pertains to the discipline of architecture and the topic of architectural design. Iacoboni highlighted the potential crossovers in some disciplines.

> "...we have preliminary evidence suggesting that mirror neurons are important in various forms of social identification, including 'branding' and affiliation with political party. Have you heard of neuroethics, neuromarketing, neuropolitics? You will in the years and decades to come,

[38] Iacoboni, Marco. *Mirroring People: The New Science of How We Connect with Others*, 62. New York: Farrar, Straus and Giroux, 2008.
[39] Ibid., 67.

and research in these fields will be rooted, explicitly or otherwise, it the functions of mirror neurons."[40]

I believe architecture is one of these fields that could greatly benefit from the understanding of mirror neurons. Following are some of the possible applications in architecture.

6.5: Specific uses of mirror neurons

Finally, we can look at some of the possible architectural applications of mirror neurons. There are a great number of possible ways that each discipline could be integrated into another in order to develop positive results, such is also the case with architecture and neuroscience. We will look at some of these possible applications with the specific focus of our knowledge of mirror neurons.

I believe that if we as architects can communicate to a person what the intention or goal of the architecture is more clearly, they will then be more comfortable in that space because they will understand the situation, be prepared for the environment that they are entering, and can be happier and more focused in that space. I believe that we can achieve this through the stimulation of the mirror neurons in a person's brain by way of visual, auditory, or tactile influences. In a sense, architecture can trigger the understanding on a neurological level and cause them to be more comfortable in a space. In order to accomplish this we need to understand how to communicate that intention or goal.

We have seen that mirror neurons can aid in this process of communicating an intention or goal, because that is one of the main topics that mirror neurons are interested in. Let's look a little more closely at how mirror

[40] Ibid., 7.

neurons perceive the goal in the context of architecture. When a person sees a door, they understand its qualities of wood or metal o glass but they also immediately consider the purpose of the door and the goal that it produces. The goal is to get from one side to the other, from inside to outside, from one room to the next. These mirror neurons fire when we see a door, but they aren't focusing on the information of the material of the door, they are retaining and communicating information about what the door is for, how we ought to use it, and the expected goal with its use. When we understand the goal, this door automatically is settled in our minds as acceptable, comfortable, and easy to operate. Automatically, the mirror neurons in our mind, before we really have time to consciously consider the situation, have told us that this thing in front of us will help us achieve a desired goal and we are comfortable with that information.

Consider now, that it is a type of 'door' that we have not seen or utilized before. This door is a more complex system and is much less intuitive. Your intention is to enter the building but what is the goal of this complex thing in front of you. There is no clear door in front of you but rather a ramp. This ramp begins to wind and turn until it is actually taking you away from the building. You aren't very clear on why this is happening. You then enter a booth that has no windows or perceptible buttons. You realize that as you press your hand on the metal panel in front of you, the entire booth moves along a track and brings you inside the building. This was your door, and it was terribly confusing. Most importantly, you didn't understand what the goal of this winding ramp and odd booth were for. Your mirror neurons were unable to recognize any sort of intention or goal, and therefore you were left to your conscious reasoning to try and figure out the procedure. This is a bit of an odd example but I am using it to illustrate this point: if a person has no means of understanding the goal or intention of an object or a space in a building, they are much more likely to be uncomfortable, confused, and uneasy in that situation.

Consider an fMRI (functional Magnetic Resonance Imaging) room. What is the goal? The goal is usually to scan the brain of a person to find some sort of problem and develop the process of solving it. The goal is to help heal a person. If a person walks into and fMRI room and are heartily intimidated, scared, and uneasy because the space is just that: intimidating, then they are not going to be comfortable or relaxed. This could even skew the results in some scenarios. However, if a person walks into a room that is obviously a place of healing and of comfort, a person will be receptive to this goal and will respond positively to it. Our mirror neurons will acknowledge the goal of a space and effect our opinion and understanding of it before a sign or comment from someone will. We as architects need to remember this and work to design a space that communicates these goals effectively. I believe one of the main ways we can do this is to attempt to trigger these mirror neurons in a positive way. Let's look at one more example that can be helpful in our understanding of how to do this.

The classroom has a goal; to educate students and prepare them to be successful in careers, families, and countless personal and social situations. In order to do this, the student has to be willing to learn and the classroom and educator has to meet the needs of the student. Again, the main needs of the student, beyond simply needing to learn, are comfort, understanding, focus, and happiness. In addition to this some of the important factors that go into a day for a student are collaboration or group work, reading or studying, testing, presenting, and listening or watching. The success of all of these topics can be facilitated by a successfully designed classroom or school or they can be hindered by a poor design. Let's look at the idea of group work or collaboration and see how successful design can trigger useful mirror neuron response to help a student be more comfortable and successful in a space.

When a student walks into the traditional classroom space on the first day of school, there is some sort of white board or presentation board at one end of the room, usually the 'front.' There is some sort of desk for the teacher near that

end of the room as well. Then there are usually rows of individual desks aligned neatly all facing the same direction, the 'front' of the room. As a student enters, their mirror neurons are telling them several things. The goal is to learn, the goal is to sit at a particular desk, face the front of the room and listen or watch the teacher go about their duties of teaching. The student enters the room comfortable with this idea because the design of the room and organization of the space makes it abundantly clear, at least through the lens of the mirror neurons, that this is the goal of such a room.

What happens then when the teacher announces that the students will be working in small groups for the duration of the school year, something happens. The perceived goals and the actual goals are not the same. The student, by way of their mirror neurons as well as their other reasoning faculties, deduced that they would be facing the front and listening. See it is the physical space that triggers these mirror neurons, not simply another person. Now their perceived goals have to radically shift. What was at one time a comfortable environment now is in flux and can potentially be a very uncomfortable environment for the student. What was the problem? The design and organization of the space did not properly communicate the goal of the space and the function that the student would have in the space. What could be the solution? We will look at a case study that addresses this issue. Then we will look at two other case studies that address the possibilities of mirror neuron response.

Chapter 7: Case Studies

We will now look at some case studies that highlight the different possibilities of the application of mirror neuron research into the architectural design process. The purpose of these case studies is to show how successful projects might have effectively employed the concept of mirror neuron response into their designs.

Case Study 01 - Dane Court Grammar School

We will look at a case study of how the architectural firm Gensler, London Office, redesigned and revitalized a group of 150 schools in Kent County, U.K.[41] beginning in 2005-2006. We will specifically look at one school located within Kent County: Dane Court Grammar School. Before we look at the details of this case study, we must first be clear on the scope of what we should be focusing on and the different topics within this study that we are not interested in. First, the purpose of this case study is to highlight how the redesign of the spaces made the goals clear and understandable for the students, thus activating their mirror neurons in specific ways and producing positive results. Also, we are interested in how the designs used topics and elements that were recognizable to the students based on their past experiences. Then we will see how this new approach of the design solution was successful from the lens of potential mirror neuron activation. I will explain how it is likely the triggering of mirror neurons aided the students in finding these spaces successful. Ultimately we will look at

[41] Nayer, Jean. "Building the Future." *Contract Magazine*, July 1, 2007, 74-79.

how similar methods can be applied in the future. It is important to note here that, to my knowledge, no case study exists that claims the use of the topic of mirror neurons in their design process, thus enhancing understanding and comfort. This case study then is looked at with a perspective of these mirror neurons being triggered unintentionally, or unknowingly, but was successful nonetheless. It will serve as an example of the potential success of mirror neuron application, especially when attention is given to the topic during the design process.

The general premise of the Kent County school redesign was this: the schools were not adequately preparing the students to be successful in the workforce. There was a need to overhaul the curriculum and with that there was a need to facilitate the way that this new learning style was implemented. With this need in mind, Kent County established the "Nurturing Autonomous and Creative Learners: the Kent Secondary Strategy." This was their goal:

> [The] "Nurturing Autonomous and Creative Learners: the Kent Secondary Strategy" ...aims to re-invent education for the 21st Century. We aim to develop virtual and physical environments in which access to learning can occur anytime / anyplace. Most importantly we aim to provide an education which is relevant to the needs of the contemporary learner as well as to the demands of the current and emerging economy.[42]

The steps to achieve this strategy included a redeveloped curriculum, an integration of much more advanced technology, and a redesign of the physical school to accommodate and facilitate these needs. We will touch lightly on the curricular changes as well as the introduction of technological advancements, and then will focus more heavily on the design changes that were developed and incorporated.

[42] Gillard, Philip. "Kent Schools BSF: Dane Court Grammar School, Stage D Design Report." Unpublished work, Gensler, Broadstairs, U.K., 2007.

At that time in Kent County there was an economic depression that developed a deprivation in many categories, one being education and educational facilities. There was a need to revitalize these educational facilities which required a refreshed approach to education. Among the goals and plans of Kent County to develop was the following:

> A transformation of learning in schools through a redesigned and tailored curriculum and ICT-rich learning environment. A wide-ranging academic and vocational curriculum offer will sit alongside a diversity of learning methods to be employed, including coaching, project-based learning, small group work, large master classes, mentoring, advisories, presentations and internships.[43]

As evidenced with this statement, the curriculum, technology, and design needs were inherently linked in Kent County's perspective. No one topic could operate independently nor could it function without the equal growth and development of the other two topics. This goal of "wide-ranging" curriculum was a bold strategy that the county believed would help these schools grow.

With these goals in mind, a new approach to accommodate these curricular goals was developed. Gensler, in conjunction with Dane Court Grammar School, produced an "Educational Vision" that consisted of:

> 4 learning 'worlds' of cross cultural adjacency. Physical World (Design Technology, Science and Physical education), Human World (English, Geography, History and RE), Creative World (Art, Drama, media and Music), [and] Social World (Sociology, Psychology, Business Studies and ICT). MFL and Maths are independent of the worlds.[44]

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[43] Gillard, Philip. "Kent Schools BSF: Dane Court Grammar School, Stage D Design Report." Unpublished work, Gensler, Broadstairs, U.K., 2007.
[44] Gillard, Philip. "Kent Schools BSF: Dane Court Grammar School, Stage D Design Report." Unpublished work, Gensler, Broadstairs, U.K., 2007.

These worlds also became the primary driving topics for the development of the new design of the school, which we will discuss in more depth later. This driving vision for curriculum enhancement was the catalyst for the design and was held in mind throughout the process.

The main approach for the introduction of technology was to "create learning spaces with cutting edge ICT resources to inspire high levels of engagement and attainment."[45] ICT (information and communications technology - or technologies) "is an umbrella term that includes any communication device or application...as well as the various services and applications associated with them, such as videoconferencing and distance learning."[46] The goal of Dane Court Grammar School was to integrate large presentation technology, laptop desks, and various other technology-based resources for the teachers and students to use throughout the course of the day. They strove to encourage technology and collaboration at every level of their school.

The success of these strategies was still dependent on a facility that could actually support the integration of these new approaches. It was *imperative* that the design of the school be changed, not only to accommodate these new type of spaces but to encourage the growth, development, collaboration, and success of the students as well as the teachers. This is why the design held such an important role in the eventual academic improvement that was seen at Dane Court Grammar School (which we will see at the end of this case study). Throughout the design brief, it is never stated that mirror neurons were a topic of discussion. This makes sense as the idea of mirror neurons is such a new concept in the context of architectural application; thus the entire purpose of this section of the document! Although it may not have been a consideration for the

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[45] Ibid.

[46] "What Is ICT (information and Communications Technology - or Technologies)? - Definition from WhatIs.com." SearchCIO. Accessed February 12, 2015. http://searchcio.techtarget.com/definition/ICT information-and-communications-technology-or-technologies.

designers, I believe that the triggering and successful integration of mirror neuron stimulation and reaction in the students was one of the main successes of this newly redesigned school. Let's look now at some of the design decisions that were made, their probable involvement with mirror neurons, and their success as related to academic improvement for Dane Court Grammar School.

With the need to restructure the curriculum and integrate technology into the school, it became evident that there was a need to redesign the way the schools functioned and how the spaces were utilized. After analyzing the issues, they learned that "...not only are the traditional school facilities ill-equipped to serve modern teaching techniques and learning methods, but their design often promotes anti-social behavior, such as smoking in bathrooms or bullying in corridors."[47] The mission then was to fix this! Kent County teamed with Gensler to accomplish this mission.

Gensler's approach highlighted a few key topics: there was a need for the entire school to think differently about how a school functioned, there needed to be more attention to the visual or kinesthetic learners, and there was a need to adjust how the students actually interacted with each other in the different spaces. Dane Court Grammar School added this goal statement:

> A re-structuring of our schools to drive and support collaboration and distributed leadership and enable us to create the human scale environments that are necessary to properly support personalised learning. Clusters, Education Improvement Partnerships, Federations and the school within a school will form the essential building blocks.[48]

In order to accomplish this, Gensler, as previously stated, developed four different academic "worlds:" a Physical, Human, Creative, and Social world. The

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[47] Nayer, Jean. "Building the Future." *Contract Magazine*, July 1, 2007, 74-79.
[48] Gillard, Philip. "Kent Schools BSF: Dane Court Grammar School, Stage D Design Report." Unpublished work, Gensler, Broadstairs, U.K., 2007.

main goal of these different worlds was to develop an adjacency that crossed curricular topics. These worlds were then arranged to be the framework for the rest of the design of the school as shown in figure 10. One important thing to note from the perspective of mirror neurons is that the idea of different "worlds" is very understandable to a child. They are comfortable with the notion that there could be significantly different information presented in each one. Although the student could be disoriented or uncomfortable with such a radical shift in curricular and spatial arrangements, the use of easily recognizable ideas was the first step in helping the students perceive the intent or goal of the space and understand and be comfortable in this new environment. Within each world there was also a somewhat radical approach to the organization and use of the spaces. These changes can impact the learning potential of a student so it was important that the design of each space within the world also employed these tactics of recognizable ideas and more importantly that they designed specific spaces to accommodate the different learning and operational needs of the students.

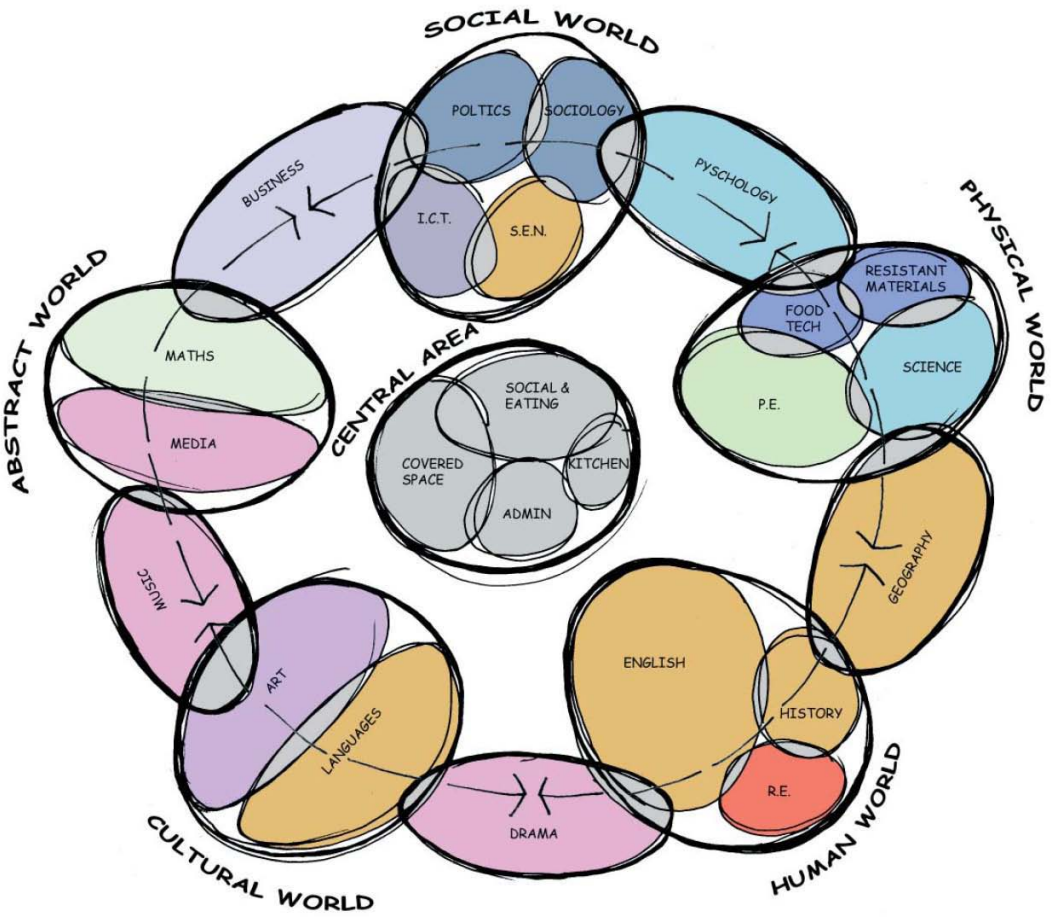

Figure 10: Academic "Worlds"

Source: Gillard, Philip. "Kent Schools BSF: Dane Court Grammar School, Stage D Design Report." Unpublished work, Gensler, Broadstairs, U.K., 2007.

Now we will look into one of these worlds and see how the spaces are arranged and ultimately look at the probable mirror neural stimulation that occurs within each smaller zone. Figure 11 shows how one of these worlds, the Physical World, is organized. Different zones hold different purposes, whether they are teaching, collaboration, technology, reflection, or gathering spaces. This space diagram was then converted to a schematic drawing, show in figure 12. These different spaces translated into the "cave," "campfire," "watering hole," and "heart" of each world. We will look at the usefulness of each of these different spaces now.

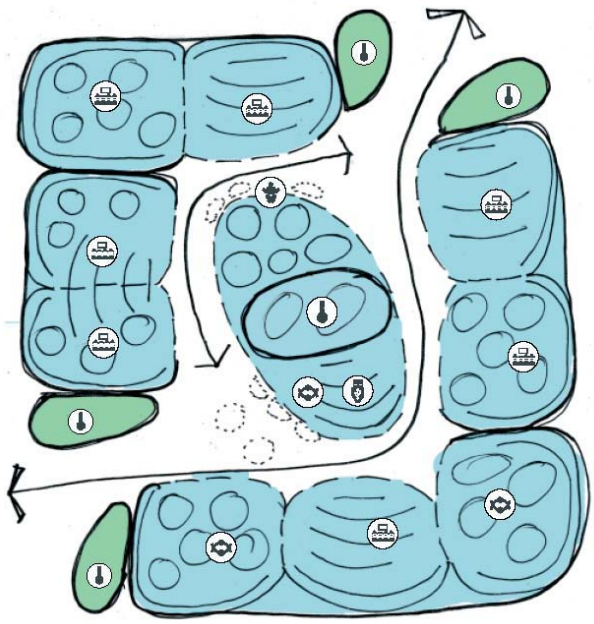

Figure 11: Physical World - Schematic Sketch

Source: Gillard, Philip. "Kent Schools BSF: Dane Court Grammar School, Stage D Design Report." Unpublished work, Gensler, Broadstairs, U.K., 2007.

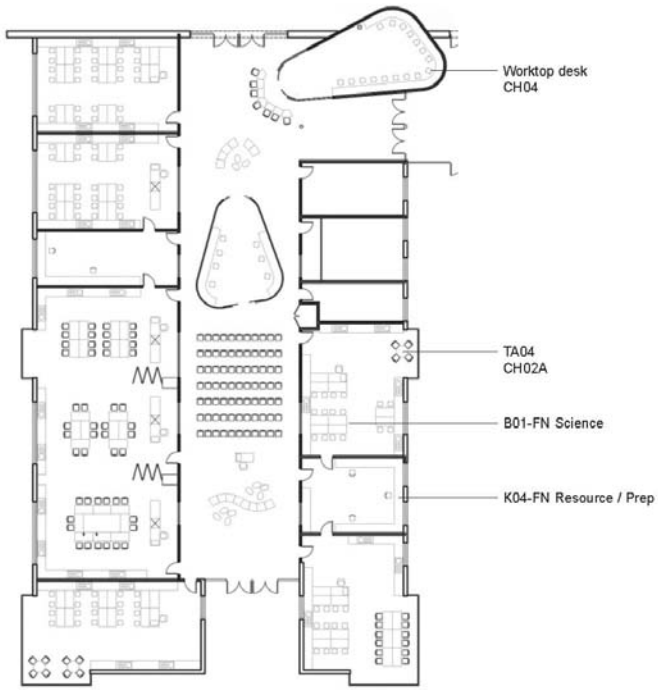

Figure 12: Physical World - Schematic Design

Source: Source: Gillard, Philip. "Kent Schools BSF: Dane Court Grammar School, Stage D Design Report." Unpublished work, Gensler, Broadstairs, U.K., 2007.

With a need to think differently about the way students learned and operated, Gensler applied new terminology to the different spaces. As is highlighted in the article in Contract Magazine[49], they called the areas of more personal learning and interaction "caves," areas of small to medium sized groups "campfires," the different gathering spaces "watering holes," and the large open areas and function spaces the "heart." The success of these terms is that they are very recognizable to the students as an abstract concept. There is already an idea or goal associated with them but they are not the traditional terms like meeting hall or corridor. The importance of this is that the students still had some level of familiarity to it but they weren't stuck with the same old ideas of how to use a school. This was necessary in finding the balance between an innovative curriculum and something that still was relevant and understandable for a student. In addition to this, these new terms also gave the students an understanding of the possible functions of the spaces because each term had a recognizable idea of space and use already associated with each one. In all of these, the activity that is necessary for the day drives the way the spaces are precisely used. Also, in each of these spaces, the integration of different technologies assisted the additional goals of catering to the visual or kinesthetic learner in addition to the traditional learner. Now we'll see what each of these spaces accomplished.

The "cave" is intended for a more personal interaction and often could be used for individual or very small group work. In nature, the cave has the connotations of privacy, shelter, enclosure, and protection. The name helps a student associate this space with the ideas of the natural cave. This is already beginning to stimulate the mirror neuron responses in their brains. They are associating the name with a comforting idea and they are likely to already be more comfortable in this space. In addition, when they enter this "cave," they already have some sort of idea as to how this space is intended to be used. In addition, the smaller, more intimate space that has been designed reinforces

[49] Nayer, Jean. "Building the Future." *Contract Magazine*, July 1, 2007, 74-79.

their assumptions that this space truly is like a cave. Because of the auditory input of the word "cave" and the visual and even tactile experience, the mirror neurons in the student's mind has communicated the motor functions of rest, calmness, and static work as opposed to the functions of high activity, motion, or even loud noises or actions. These themes of stimulating mirror neuron function will be seen in each of the additional spaces.

The "campfire" is designed to allow a medium sized group to interact and collaborate. Again, this idea of a campfire is quite common to most students with connotations of relaxed communication, gathering around a common goal (warmth or light), and a specific time to focus on a single activity. This again stimulates the student's mirror neuron responses to prepare for that style of activities. When we think of a group project, we immediately tense mentally; we expect contradiction, difficult communication, and a lot of work. When we think of a campfire, we relax; we expect comfort as well as happy interactions and conversations. Also, the physical design of casual yet focused spaces with the attached association of a campfire, sets these students up for success. The design of these spaces is internally focused with groupings of chairs in a circle with no clear head of a table or group. The moment the student sees this type of space, the mirror neurons are firing and preparing the student to think about group interaction. The student is already more likely to be calm about the situation because they are prepared to work in a group, as opposed to how they might be caught off guard if they walked into a classroom with all the desks in a row then told to gather into groups. The design of the space triggered the understanding, via mirror neurons in conjunction with other senses, projecting the association that group work would be happening. The students were prepared because they understood the intention of the space, and the inner-workings of their mind and body were already acclimating to the situation.

The "watering hole" is designed for a larger interaction with various different uses. In nature, the watering hole is where all the different groups gather

and share in a common goal or experience. There is usually a sense of taking turns, and there is also a sense of hierarchy among the participants. Similarly with the "watering hole" in the classroom, these students are being prepared for a more variable interaction with a larger group of people. The design of the space also suggests that there is a specific goal in mind, but there is no rigorous definition of space. There may not be walls designating the extent of the boundaries so there is freedom to choose the space that each student is most comfortable with. Again, this is triggering the exact same perceptual responses in the student via the mirror neurons. They are mentally prepared for a larger interaction, they know that each time the activity might be different, and they are offered the opportunity to choose their own personal space among the group. The auditory responses of "watering hole" and the physical design elements that cater to this space usage are directly impacting the student's emotions and behaviors in a very positive way.

The "heart" is designed with the intent of bringing everyone together and also giving the students a sense of an anchor. The heart in the body holds the connotation of the life giver. It is the tool that is at the center of our bodies, and metaphorically where our emotions and thoughts originate. This triggers in the students the notion that this heart is what holds the entire school together. The heart is perhaps the least obvious in its physical design manifestation, as it is the space surrounding much of the activities. The heart does, however, manifest itself mostly as the center of the building, the center of the spaces. Visual cues as well as circulation paths always bring the student back to the heart. Just as a student isn't focused on their heart throughout the day, this heart in the school may not be the focus. However, if a student's heart "hurts" or feels as though it is empty or without satisfaction, it can cause great distress. Similarly, if the heart of the school isn't established, or students couldn't perceive that there was an anchor to all the spaces, they could find themselves struggling to connect with the entire school. The mirror neurons in their minds are responding to the obvious and the subliminal, and this more subliminal heart attachment is just as

important to the student understanding the space. The goal of the heart in the body is to keep everything together, and the student perceives the same thing here.

These main design spaces manifest themselves differently in each "world" and take different positions of importance throughout the day. Although these subtle changes occur, the student is able to perceive the great importance of the spaces. The mirror neurons in their minds help them to relate to the space and understand just what their goals can and should be while in that space. The focus and comfort of a student is critical in their ability to receive and retain information, especially in an educational environment.

One additional thing that this allows is the ease of the mind with the topic of mirror neurons. Remember how earlier we addressed that when these mirror neuron firings are not necessary we block them out and override them? Well, if we design a space that is triggering these neurons to fire at the appropriate times in the appropriate settings, then we do not need to block out this wonderful tool but rather allow it to aid our minds in finding comfort and understanding in the environments that surround us! The design of these spaces and the redesign of the Dane Court Grammar School, as well as the other schools in the project, was an integral component of the successful revitalization of the educational level in Kent County.

Although the impact of the physical redesign of the schools is very difficult to properly quantify as it was one portion of a larger initiative to improve the standards of the county, there is evidence that shows the improvement of the education levels over the last eight years. In the appendix you will see the Ofsted inspection reports from 2007 and 2011 as well as the 2015 performance tables from the Department of Education. The 2007 inspection report was generally complimentary but there were a few key points that needed to be addressed. Although their grade 1 and 2 standings were successful, their grade 3

and grade 4 standings were satisfactory and inadequate respectively. This highlighted an issue that was addressed in the final assessment to the school: "Your school needs to develop the curriculum so that there are more vocational options for you to choose from and it needs to move forward with the planned developments to the site, so that you have better spaces to learn in."[50] These simple sentences were among the catalysts that set in motion Kent County's goal of improvement. Other schools in the county received similar feedback but Dane Court Grammar School had perhaps one of the best examples of growth over the last eight years.

In 2011, an interim inspection report was filed. If the school was falling below the expected success levels, then the school inspectors would have to come out to do a more comprehensive inspection to see where the deficiencies lay. This was not necessary, however, as the interim report stated, the "interim assessment shows that the school's performance has been sustained and that we can defer its next full inspection."[51] This signified substantial growth. Currently on the department of education website, Dane Court Grammar School holds wonderful statistics and is now one of the higher ranking schools in the county. This report is also found in the appendix. This statistical information shows that there has been substantial improvement in Dane Court Grammar School. This was due to a large variety of factors, but the attention should be focused on the goals that Kent County established and where they believed their educational success would come from. Kent County's mission to improve their area with the threefold approach of curriculum adjustment, technological advancement, and architectural redesign appeared to be the necessary solution. They believed that the curricular and technological improvements would not be effective without a design of a school that could properly accommodate such a leap forward. Kent County placed great importance in the necessity of architectural design in education.

[50] See Appendix, 2007 report, p11
[51] See Appendix, 2011 report, p1

This is an example of a design that addressed the need to understand and design with the knowledge of mirror neurons. Although it does not appear that there was an intentional process of considering mirror neurons in the design process, the result appropriately stimulated the effectiveness of proper mirror neuron stimulation anyway. Consider if the designers for this project had the clear understanding of mirror neurons in their design 'toolbag' before they began the project. How much more could they have added to the quality of the design?! The possibilities may be endless but the truth remains, the clear understanding and proper application of the triggering of mirror neurons can aid the design of a space tremendously.

Case Study 02 - Google Headquarters

The next case study we will look at is the Google Headquarters in Mountain View, California. The master planning and interior redesign was completed in 2005, led by Clive Wilkinson Architects. The Google Headquarters, also known as the Googleplex, introduced a radical shift in the way that the company organized their offices. It is this shift that we will look at more closely and see how the effect of mirror neuron responses may have been involved.

Again, before we look at the details of this case study, we must first be clear on the scope of what we should be focusing on and the different topics within this study that we are not interested in. The purpose of this case study is to highlight how the redesign of the spaces made the goals clear and understandable for the employees, and how it promoted collaboration due to the different designs of the spaces. Also, we are interested in how the designs broke away from the accepted norms of traditional office environments and introduced recognizable and understandable designs so the employees would be encouraged to work together more comfortably and be more productive and

innovative. The topic of mirror neuron responses will be integrated within each main point.

Let's look at the general scope of the project and how the firm responded. "In early 2004, with its upcoming IPO and aggressive expansion policy, Google undertook a strategic reevaluation of its workplace processes."[52] Google, as its interests have always been, wanted to revitalize the workspace and facilitate new ideas and new methods of workspace productivity and production. Clive Wilkinson Architects won a design competition that Google held because their design "create[d] a diversified campus environment, integrating highly focused software engineering workspace within a support system of learning, collaboration, recreation, and food facilities."[53] Some of the ways that they developed these spaces of learning, collaboration, and recreation was by the design of glass rooms instead of walled offices, eliminating the traditional cubicle, 'tech talk' areas for more formal learning, white boards along the 'main street' for more informal learning and interaction, and all of this was designed with the common goal of a "loosely structured university system."[54]

This loosely structured university system is the framework with which the success of the rest of the design rests. This system is immediately recognizable to most employees because a majority of employees are likely to have some amount of formal education at the university level. Google doesn't divulge the exact percentage of college degree holders versus non college degree holders, but it is likely that a majority hold degrees. Regardless, nearly everyone has had some type of formal education before and this idea a university environment can be very understandable. Some of the points that Clive Wilkinson Architects highlighted were this:

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[52] "GOOGLEPLEX: A New Campus Community." Clive Wilkinson Architects. Accessed February 25, 2015. http://www.clivewilkinson.com/case-studies-googleplex-a-new-campus-community/#!
[53] Ibid.
[54] Ibid.

> In a university environment, you typically have the option of self-directed work, a selection of work styles or work environments, independent study subject choices, either private or within a group... At the university level, these opportunities are to support the goals of personal education, with a focus on each individual's interests, but when these interests become common to a community, the results can be very powerful.[55]

This is a very successful technique when we look at the design decision through the lens of mirror neurons. Again, designing in a way that is recognizable for the individual is very likely to trigger mirror neuron responses. The university setting is often about innovative ideas, trying new things, pushing normal social conventions, collaboration, and a self-directed perseverance. When the employee walks onto this Google complex, their mirror neurons begin firing as the idea of a college campus becomes clear to them by way of the design and layout of the spaces. Immediately, due to these neural responses, they are subconsciously preparing themselves to operate in this highly collaborative and innovative manner. The design of the spaces that they will occupy and utilize has a huge impact on the way that they will operate and think on a daily basis. As these mirror neurons continue to fire, they will continue to maintain the mindset of innovation and function often found on a university campus.

The decision of Clive Wilkinson Architects to utilize this powerful analogy is the backbone of their success from the lens of mirror neuron responses. Although there is no evidence that Clive Wilkinson Architects directly considered mirror neurons within their design process, I believe that they are activating these neural responses. Where this architect knew by experience or instinct that there was a need to design relatable spaces, we now can consider also the neurological implications and opportunities of our design decisions!

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[55] "GOOGLEPLEX: A New Campus Community." Clive Wilkinson Architects. Accessed February 25, 2015. http://www.clivewilkinson.com/case-studies-googleplex-a-new-campus-community/#!

In support of the university style system, Clive Wilkinson Architects also innovated the way that the employees at this Google complex worked and interacted. Instead of the traditional walled, closed off offices, more open and transparent offices were designed. These are the "glass rooms" seen in figures 13 and 14.[56] These glass rooms offered a metaphorical and literal transparency to the way that employees met and discussed ideas. These glass rooms encouraged more collaboration, as everyone could see who was in the rooms and what was going on inside them.

Figure 13: Glass Rooms

Source: http://www.dezeen.com/2014/03/17/office-design-google-clive-wilkinson-interview/

[56] "Google Was Cubicle Land When We Started Designing Offices for Them" De Zeen Magazine. Accessed February 20, 2015. http://www.dezeen.com/2014/03/17/office-design-google-clive-wilkinson interview/.

Figure 14: Glass Rooms 2

Source: http://www.dezeen.com/2014/03/17/office-design-google-clive-wilkinson-interview/

As the employees enter a room with transparent walls, again their mirror neurons are triggered. They are immediately tuned to the idea that whatever they do must be inclusive and transparent because they physically cannot hide in any way. This simple design decision to use glass instead of a more opaque material changed the way that the employees operated, and mirror neurons helped them to be comfortable with this idea as they entered. If the employees meet in dark, closed off offices and then they are encouraged to be very open and transparent with the results of that meeting, there is subconscious resistance to that idea because the encouragement contradicts the environment. When the goal and encouragement of a task compliments the design of a space, or vice-versa, then a person is inherently more comfortable and at peace in their own mind and emotions. The transparent rooms trigger the mirror neurons which communicates the need for the employee to also be transparent. With this mental

understanding, the employee will be much more comfortable and likely to be willing to share the information, as this appeared to be the goal all along in their subconscious thinking and reasoning!

Another design decision that encouraged collaboration was the introduction of white boards along the 'main street.' This analogy to a main street (shown in figure 15) again helps the employee understand the intentions of the space better. The idea of a street is for travel - getting from one place to another. The introduction of the white boards along this street is the great design addition that can really stimulate the mirror neurons in a person. These white boards are already understood to be used to write down ideas, to communicate, and also to collaborate with others. Placed along the main street of travel, these white boards encourage communication with those traveling along it. Mirror neurons are triggered by the white boards, the employee is already now thinking of collaboration and communication, and then another employee strolls by; now they are both more prepared to stop and discuss. The mirror neurons in each employee are firing and sending signals, encouraging them to see that although this is a transient space, it is also a place of discussion and pause. This is consistent with the original goals of Google to incorporate diversity and interaction.

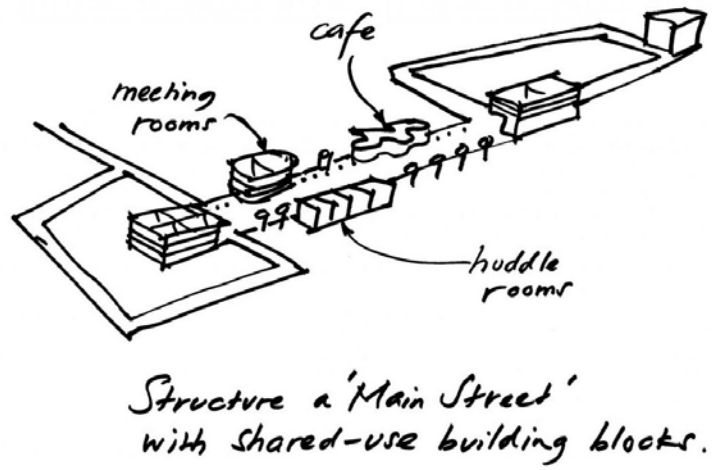

Figure 15: Main Street Sketch

Source: http://www.clivewilkinson.com/portfolio_page/google-headquarters/

The effectiveness of these simple yet powerful design decisions reach much further than simply white boards and markers along a path; they educate, remind, and trigger emotional and physical responses in the employees in positive, useful ways. Let's look at a few other ways that Clive Wilkinson Architects accomplished these responses.

Although casual interaction and collaboration was necessary, so was a more formal interaction between employees. This was accomplished in more enclosed rooms designated for 'tech talks' "...and formal lecture areas were provided where learning or teaching could occur in an organized fashion..."[57] as seen in figure 16. These more traditional rooms served the purpose of the most personal, focused lectures and learning settings in the office. This design again helped the employee understand the intent of these rooms. The mirror neurons again are firing and helping the employee understand that these spaces are more for a lecturer/learner environment. These spaces did not intend to convey an idea of collaboration as much as they intended to convey an idea of focused learning and absorbing. The mirror neurons are able to pick up on these intentions and help the employee subconsciously understand them and they are immediately more prepared and comfortable within the space.

These spaces continue to show how, when the space is designed to relate to a person and be understood, a person can be more comfortable in a space. Although a host of factors develop this comfort, mirror neurons play a big role in this process and they are often the factor that initiates the process of understanding. We will look at one more idea that was central to the office environment for the Googleplex: the elimination of the cubicle.

[57] "GOOGLEPLEX: A New Campus Community." Clive Wilkinson Architects. Accessed February 25, 2015. http://www.clivewilkinson.com/case-studies-googleplex-a-new-campus-community/#!

Figure 16: Tech Talk Rooms

Source: http://retaildesignblog.net/wp-content/uploads/2012/11/Googleplex-offices-Mountain-View-04.jpg

According to Clive Wilkinson, "Cubicles are the worst - like chicken farming. They are humiliating, disenfranchising and isolating. So many American corporations still have them. I'd say 75-80 percent of America is cubicle land. They still want six-feet-high panels around cubicles..."[58] In response to this concern, Clive Wilkinson Architects adapted the traditional cubicle slightly to balance the need for focus and the need to communicate and collaborate. As seen in figure 17, the traditional individual cubicle is broken up and now several workstations are clustered together. In addition to this cluster of spaces, the partitions between spaces are reduced and made more transparent, offering

[58] "Google Was Cubicle Land When We Started Designing Offices for Them" De Zeen Magazine. Accessed February 20, 2015. http://www.dezeen.com/2014/03/17/office-design-google-clive-wilkinson interview/.

more communication to other clusters as well as employees moving through the shared spaces.

Figure 17: Adapted Cubicles

Source: http://www.dezeen.com/2014/03/17/office-design-google-clive-wilkinson-interview/

This more open plan and clustering of spaces once again triggers the mirror neurons and helps the employee understand that their work will not, nor is it expected to be, done in isolation. As they use this space, they are constantly reminded that this is a space of collaboration and communication and therefore they are much more likely to be comfortable with the interaction that is necessary to occur in this work environment at the Googleplex.

This consistent reaffirmation of Google's goals and vision through the design of the space serves to make this Google complex extremely successful.

Clive Wilkinson Architects saw a distinct need for the office spaces at Google to be more open, more accessible, and more flexible to encourage a stronger collaboration and more open communication among its employees. The design tactics employed serve to trigger mirror neurons in the employees minds, helping them understand the spaces better, be more comfortable in the spaces, and ultimately produce a higher volume of work and likely a better quality.

The success of this space can be measured in several ways, one of which is by getting a firsthand account of how this space is appreciated by its very employees. On their careers page, a broad description of the Googleplex and its qualities are highlighted.[59] It's interesting to note that the company pays so much attention to the design of the space and not just the work that they do. This shows how important and successful the design of this space really is.

First, they make it clear how hard they intend to work, but also how important flexibility in their personalities is. "We expect a lot of ourselves, but don't take ourselves too seriously."[60] This is supported by the flexible spaces designed into the building. In addition to that, they call attention again to the necessity of quality collaboration in the workplace. "...collaboration is core to our work and a key to making good ideas become great ones."[61] As this was one of the clear intentions of Clive Wilkinson Architects, it is clear that these two groups are in agreement of the necessity. This is further clarified by the following statements:

> "The Googleplex has grown over the years. We're fond of doing things differently, so you'll find unique places scattered around the Googleplex. Creative environments like our flexible workspace—we call it

[59] "Mountain View (Global HQ) - Google Careers." Mountain View (Global HQ) - Google Careers. Accessed February 20, 2015. http://www.google.com/about/careers/locations/mountain-view/.
[60] Ibid.
[61] Ibid.

the Garage—allow Googlers to get out from the behind their desks, experiment and find inspiration for their projects."[62]

Additional spaces are continually being added as the need arises in different situations. The "garage" mentioned above is a flexible space that helps encourage all of Google's employees to continue to outreach and collaborate. There is a resounding note of success within the office and there are similar reactions to these spaces in the other Google offices, modeled similarly to the design decisions at the Googleplex.

In addition to this method being used for other Google offices, Clive Wilkinson Architects has employed these similar design sensibilities in other projects for different large companies. One of significance is the Macquarie Investment Bank in Australia. This notion of open floor plan, clear offices, high transparency, broad collaboration, and clear communication has also seen success outside of Google. This success is so evident in the bank culture in Australia that Clive Wilkinson recalls: "I was told by Macquarie people...that pretty much every other major bank in Australia had picked up this way of working because it made sense to give people choice and liberating them from paper, and reducing carbon footprint."[63] This excitement by other companies to model this efficiency and quality of design speaks volumes for the success of a design language.

Clive Wilkinson Architects' design of the Google Headquarters in Mountain View, California shows how a quality design can be well received by the client and also how it can help a group continue to develop and grow. With a knowledge of how mirror neurons are triggered and the positive effect they can have on a person, we can more clearly understand why these design decisions

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[62] Ibid.

[63] "Google Was Cubicle Land When We Started Designing Offices for Them" De Zeen Magazine. Accessed February 20, 2015. http://www.dezeen.com/2014/03/17/office-design-google-clive-wilkinson interview/.

were so successful. As we keep these principles in mind, we can make more informed decisions within our own personal design processes. If we decide to hold a special focus on the ability that mirror neurons have to help the users of the spaces we design, we can see great success.

Case Study 03 - Namba Parks

In this case study we will look at a slightly different approach to the triggering of mirror neurons. Here, we will look at how the incorporation of trees and plants as an integral part to the architectural design can have a positive impact on the retail experience. We will first look at some information on the importance and impact of this process and then we will look at Namba Park in Osaka, Japan and see how this design strategy can be implemented.

Before we look at the details of this case study, we must first be clear on the scope of what we should be focusing on and the different topics within this study that we are not interested in. The purpose of this case study is to highlight how the incorporation of different landscape features, closely connected with the architectural design of a space, can trigger mirror neural responses in the users of a space; specifically a retail space for this discussion. We are interested in the possibilities of natural influences in design and how it can have a positive effect on the user. Again, the topic of mirror neurons will be introduced at various points of the discussion.

Before we look specifically at Namba Park, let's look at some of the usefulness of bringing nature into an architectural work and how it can have an impact on the retail experience. In the publication "14 Patterns of Biophilic Design: Improving Health & Well-Being in the Built Environment" by Terrapin Bright Green, the topic of biophilia is introduced.

> Biophilia is the humankind's innate biological connection with nature. It helps explain why crackling fires and crashing waves captivate us; why a garden view can enhance our creativity; why shadows and heights instill fascination and fear; and why animal companionship and strolling through a park have restorative, healing effects. [64]

This idea of biophilia is not a new concept but Terrapin Bright Green does a great job to identify its main components and show how it is important to design and occupation of that design. We will look more closely at one of those components: "Connection with Natural Systems."

In this section, the importance of a space having a strong connection is highlighted. "A space with a good Connection with Natural Systems evokes a relationship to a greater whole, making one aware of seasonality and the cycles of life. The experience is often relaxing, nostalgic, profound or enlightening, and frequently anticipated."[65] Of the various responses that are activated and evoke this relationship, I believe that mirror neurons play an integral role. It is the triggering of these mirror neurons that cause the mind to associate the changing earthly seasons to the changing metaphorical seasons of a person's life. On a smaller scale, the awareness of the seasonal qualities of the landscape can help a person understand and acknowledge these changes and in turn cause them to adapt or react in certain ways.

For example, if a user is walking through an outdoor portion of a retail mall and they notice (either consciously or subconsciously) the leaves falling from the tree, they are aware that Autumn is approaching. With this notion, the mirror neurons begin to fire and relate that information to the notion that they will need to, among other needs, dress warmer. They will then, while already at a retail store, be more likely to decide to shop for the necessary clothing to be

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[64] "14 Patterns of Biophilic Design." 14 Patterns of Biophilic Design. September 12, 2014. Accessed February 22, 2015.
[65] Ibid., Section 4.1 [P7]

comfortable (as well as 'in fashion') for the upcoming season. The same can be said for the spring time when the leaves are returning. Before the customer ever sees a sign for that new ensemble on sale, they are more prepared to buy it. This can assist in the marketing and sales of not only a single store, but an entire shopping complex. We will look at this example further in the case of Namba Park.

Terrapin Bright Green supports this concept as they call attention to Stephen Kellert's book Biophilic Design, when they address the idea that "seeing and understanding the processes of nature can create a perceptual shift in what's being seen and experienced."[66] I believe that often this "seeing and understanding" is stimulated and heightened by way of mirror neurons. These neurons are the catalysts to understanding the environment around us and they possess the ability to positively influence our clarity and understanding our environment.

In addition, the difficult to measure but highly likely economic benefit of this sort of design is highlighted in the publication. In reference to the book "The effects of urban retail greenery on consumer experience" by Joye, Yannick, Kim Willems, Malaika Brengmen, and Kathleen Wolf, the concept of properly placed vegetation is addressed.[67]

> There is evidence that consumers are likely to buy more merchandise in stores with strategically situated natural vegetation. It is not a coincidence that store and mall layouts are mapped to intentionally and meticulously guide shoppers through a maze of products surrounded by strategically placed plants, trees, and skylights; small yet powerful influences over

[66] "14 Patterns of Biophilic Design." 14 Patterns of Biophilic Design. September 12, 2014. Accessed February 22, 2015.
[67] Joye, Yannick, Kim Willems, Malaika Brengmen, and Kathleen Wolf. "The effects of urban retail greenery on consumer experience." Elsevier Science Ltd. Urban Forestry & Urban Gardening 9 (2010) 57 64. Belgium. 2010.

consumers can lead retail stakeholders to enjoy greater profits if biophilic greening practices are employed.[68]

Precisely why this impact is so powerful is often associated with our psychological tendencies to appreciate nature and our desire to be in touch with it. I believe, however, that the neurological process of mirror neuron response is also intrinsically linked to this process.

It is important to note here that biophilic design often refers to simply adding green spaces - adding trees and plants to an area. I am proposing that the *right* kind of greening is necessary. Trees and plants that actually respond to the seasonal shifts, however subtle, is imperative to trigger these mirror neuron responses in the context of encouraging more shopping via different seasons.

Now we will look at a retail project that incorporated vegetation at the very core of their design concept. We will see that the goals were to bring back nature into a dense city core and cause the users to see and understand the different natural processes that take place with the different vegetation. Again, there is no evidence here that the topic of mirror neurons was in the mind of the designers for this project, but I believe they were able to trigger these responses anyway. The goal of this case study is to help designers understand that if we can keep the importance of mirror neuron response in the forefront of our thinking as we design a space or building, we can provide stronger results for the user.

"The Jerde Partnership's Namba Parks, in Osaka, Japan, was...named one of the winners of the Urban Land Institute's 2009 Awards of Excellence: Asia Pacific competition."[69] This project's goal was to break up the concrete expanse in the city of Osaka. "Jerde conceived Namba Parks as a large park, a natural

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[68] "14 Patterns of Biophilic Design." 14 Patterns of Biophilic Design. September 12, 2014. Accessed February 22, 2015.
[69] "Namba Parks / The Jerde Partnership." ArchDaily. October 18, 2009. Accessed February 22, 2015. http://www.archdaily.com/36987/namba-parks-the-jerde-partnership/.

intervention in Osaka's dense and harsh urban condition."[70] To do this, Jerde conceived a canyon-like structure topped with a terracing, flowing, rooftop garden. In figure 18, we see the early conceptual sketch that proposed to accomplish this goal of a strong integration of landscaping into the fabric of this office and retail project. In figure 19 we see this concept successfully carried out in the construction.

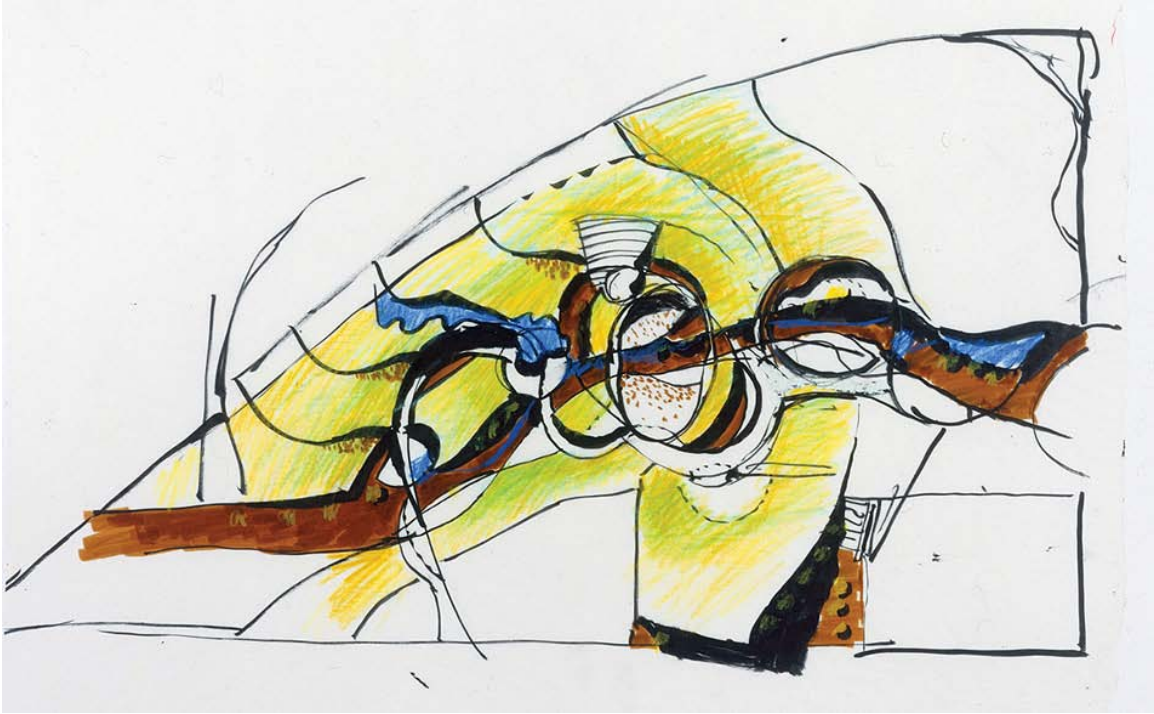

Figure 18: Concept Sketch

Source: http://www.jerde.com/

[70] "Jerde PlaceMaking." Jerde PlaceMaking Namba Parks. Accessed February 22, 2015. http://www.jerde.com/.

Figure 19: Aerial View - Terracing

Source: http://www.jerde.com/

In an interview with Jeri Oka, the lead designer for the project, Leslie McGuire from Landscape Online expounds on some of the design approaches for the project.[71] Leslie explains:

> Even the planters give you the feeling that you're on the ground. You feel as if you are within a garden, not just on a roof with planters. They tried to think of clever, easy ways to design the planters so people can also sit on them and interact with the plants.[72]

This calls attention to a critical point in the success of this project. Oka was interested in causing a very clear interaction with the plants and trees in this project. This interaction, seen in figures 20 and 21, is critical in the concept of mirror neurons. The more tangible the connection can be, the more likely it is that these neurons will be triggered. Though even a casual glance can accomplish the triggering, the more interaction the better.

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[71] McGuire, Leslie. "LandscapeOnline.com." LandscapeOnline.com. Accessed February 22, 2015. http://www.landscapeonline.com/research/article.php?id=11354l.
[72] Ibid.

Figure 20: Occupation - Entrance

Source: http://www.jerde.com/

Figure 21: Occupation - Main Space

Source: http://www.jerde.com/

Figure 22: Winter Vegetation

Source:http://2.bp.blogspot.com/XlcWoOWD6Ig/U0JUdVz121I/AAAAAAAADUo/gVGwuWoo28Y/s1600/2014-03-27+18.10.41.jpg

Oka also discusses the importance of how the landscaping changed throughout the year. "Since there are so many species, a whole program makes sure there's something different to see all year round."[73] The different species are effected differently throughout the seasons (as seen in figure 22); there is always a clear shift. "The plantings go through bloom phases with flowering dogwood, cherries, mountain peach and azaleas, as well as basic plant materials such as rosemary that survives nicely in winter. White oaks are evergreens as are bayberries."[74]

This is a critical point! The seasonal changes are the most likely factor that can cause mirror neurons in a person to be triggered in this context. They see the leaves changing and they inherently know that the seasons are in flux; then

[73] McGuire, Leslie. "LandscapeOnline.com." LandscapeOnline.com. Accessed February 22, 2015. http://www.landscapeonline.com/research/article.php?id=11354l.
[74] Ibid.

they decide that it's time to dress appropriately for the season. This is the marketable value of proper landscaping integrated very closely with the architectural design. This is the most important aspect of this case study. The changing plants and trees encourage us to shop! In turn, the shops and businesses benefit from additional marketing and sales promotions, but it's not even a sign or a salesperson, it's a neurological decision. As a person understands that the seasons change, they are already subconsciously preparing themselves to shop for the necessary goods.

It is clear to see that the greening of this project was a major influence in bringing more users to this site and keeping them there. In addition, there is a strong correlation that the more traffic you have in a given area, the more likely you are to make sales. I believe that in addition to all of this, the intelligent design strategy of incorporating plants that noticeably change in different seasons help to trigger the mirror neuron responses that help people understand the seasonal changes and in turn are more willing to shop for the necessary items.

Namba Parks in Osaka, Japan is one example of seemingly countless projects that heavily incorporated landscaping into the architectural design of the entire project. With a sensitivity to the adequate landscaping that responds well to the different seasonal shifts in that region, Namba Parks is an ideal candidate to help us understand how useful mirror neuron response can be.

The ability to positively impact the mental, emotional, and even physical state of a person by way of triggering mirror neurons is a topic that can be investigated in many more existing projects, but more importantly it can be applied in future projects. As we move forward, maintaining attention to this detail can help us be stronger architects.

Chapter 8: Process Web

With the help of a process web, we will look into the topics that are unique to architects, neuroscientists, and psychologists. Then we will see which topics tend to overlap. These overlaps will be the focus of discussion for the majority of the chapter. At the end of the chapter we will discuss the strongest overlaps that present themselves in the process web. This process web that I designed is to be used as a design mechanism for architects. While some test theory on the basis of the design of a building, this topic is more effectively communicated and tested by this framework of a process web.

First, we will look at some of the important topics that are present in these three disciplines. We will first look through the lens of an architect; the topics we are presented with most frequently and the relative importance of each of these in the topic of design process. Next, we will look through the lens of a neuroscientist. This lens will give us a glimpse into the many topics that are addressed in this discipline with a small nod toward how it is relevant to architects. Their relevance will be discussed in more detail in a later chapter. Similarly, we will then look through the lens of a psychologist. Again we will see the different pertinent topics and a brief look into their relation to an architect's design process. With all three of these disciplines laid out in front of us, we will have a more clear perspective of their overlaps and similarities, as well as their distinct focus areas and expertise.

It is important to note here that every topic of each discipline has not been added to this process web. To do such a web would be incredibly cumbersome and hardly useful in this context. Rather, the topics selected are those that have made it through a series of checks and balances to determine if their relevance had a large impact on the topic of architectural design process. Many of these topics became the focus of conversations while working at the Practicum Firm. These topics held a prominence in discussion throughout my time there as I

worked and held interviews concerning the professional experience of different architects. The majority of these architects were design directors for different project teams. Each time a major topic was discussed I would record it and add a note as to the perceived importance it held in the view of the architects.

Some of the architects working there also had backgrounds in the fields of psychology and neuroscience. Their professional experiences helped me to focus the topics included in this web as well. Throughout all of these discussions there was a very clear set of topics that held a great deal of importance in the context of the architectural design process. Again, these do not represent all the topics within each field to be discussed, but rather a cross-section of the most relevant topics that will aid this look into weaving disciplines into the architectural design process.

Before we look at the different disciplines included in the process web, it is necessary to first explain the structure of such a web. Fashioned after a crystalline structure, the honeycomb pieces have the flexibility to be moved and adjusted to respond to their neighbors based on the specific topics addressed. If at some point a number of additional topics were added to this web, it could adjust and adapt to accommodate them rather seamlessly. Also, this hexagonal structure caters itself to more than a single connection; an imperative quality in the discussion of three disciplines coming together.

As can be seen in the following figures in this chapter, there is also a color coding pattern applied. The discipline of architecture is represented in red, neuroscience in green, and psychology in blue. Just as an "RGB" color sequence has the ability to produce virtually any color, so does this web structure offer the ability to allow virtually any combination of topics to be woven together within these three disciplines. As seen also in the following figures, within each honeycomb there are additional bars of color lining the honeycomb walls. These colors represent the different disciplines that also hold some level of importance within that topic. The more bars of color present within each honeycomb

indicates the importance or usefulness of that topic in each discipline. For example, in figure 21, the topic of collaboration holds two parts of the green representing the discipline of neuroscience while the topic of shopping only holds one part green. This indicates that there is a stronger link between architectural and neuroscience practices within the topic of collaboration than there is with the topic of shopping. This does not mean that the topic of shopping is less valuable in certain circumstances, but it does give us a basis with which to focus our discussion.

This document looks to lay out some of the various topics that we could delve into more deeply, but it will also focus on a select few in order to introduce a proper investigative depth. With a need to focus, this document lays out the possibilities. Although there are quite a few possibilities, it will address the topics more specifically that have a stronger tie. Thus, we will look more deeply into those topics that have a more balanced combination of disciplines represented by the colors within each honeycomb.

As we keep this in mind, we will move on to the first discipline group: architecture. As this document is intended primarily for the architect, we will look at this discipline as the foundation with which the other disciplines will look to merge with. There are certainly different scenarios where architecture can help support the other disciplines, but that is research and discussion for another day! All of the topics have very specific definitions that can be found in countless pieces of literature or even dictionaries, but here they will be defined by what could be called 'practical usage.' There are a number of ways to define each of these terms, however I will introduce the definitions that cater to the ability for them to be understood in the discipline of architecture first, then neuroscience and psychology.

8.1: Architecture: Practical Topics

As we can see in figure 23, this web begins with the main topic of architecture and the beginning of its surroundings. Figure 24 then highlights some of the practical topics associated with this discipline: *space, form, pre-design, design, comfort, shelter, safety,* and *service*.

Space refers to everything that isn't brick and mortar in architecture. It is the area that we as users occupy; it is valuable to us because it is where we always are, where we exist in a building. To architects, space is one of our greatest interests yet is difficult to define. *Form* refers to the shape, composition, and appearance of architecture. Form is what the building looks like.

Pre-design is an activity that occurs before a pen ever touches paper and flows into the process of design, often includes a lot of questions and includes a single answer. *Design* is the process of questions, answers, testing, checking, re-trying, and concluding that will ultimate develop architecture. It does not occur in a single stage, nor is it ever fully complete in a lot of ways. The process of design is, of course, the topic of the entire discussion of this document. *Comfort* is a topic that is also difficult to define as a singular concept. Comfort is perceived differently by nearly everyone, however it holistically discusses the factors that go into a building providing the essential needs for the user and causing them to be at ease with the results. *Shelter* in its most basic definition is protection from the earthly elements; wind, rain, heat, cold, etc. In addition, it can be considered as a shelter from people, from other buildings, or from an emotional or physical environment. *Safety* refers to the need for the user to be kept from physical and emotional harm while they are occupying a building. Safety is also perceived differently but there are universal standards that help to ensure a certain level of safety in architecture. *Service* can be understood in many ways, but here we will look at the social aspect. How does architecture serve the needs of the user? This is the type of service that begins to reach out beyond the physical environment and into the social realm.

Architecture

Main Honeycomb

This is an overview of all the different topcis that are introduced in the web from this specific discipline. Each topic is separated into groups which will in turn begin to refer to the other disciplines included in the overall web.

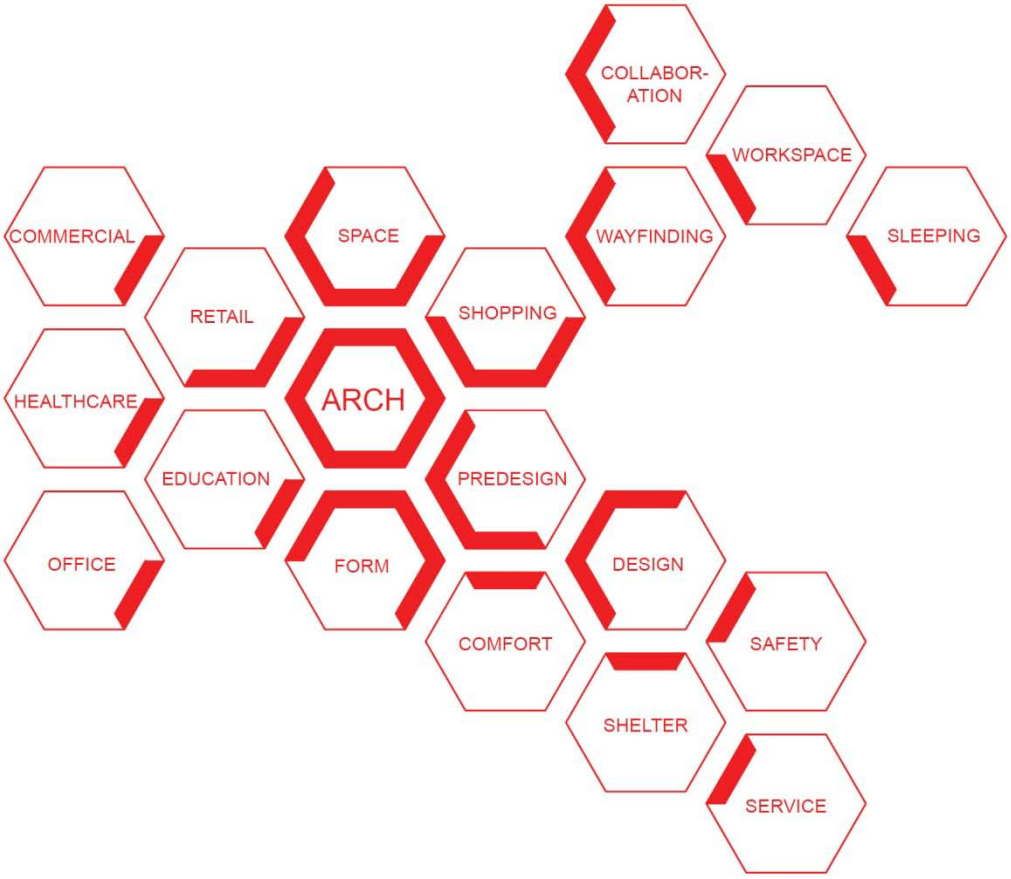

Figure 23: Architecture - Main Honeycomb

Architecture

Practical Topics

These topics consist of the more fundamental concepts, ideas, and discussions in the discipline of architecture. They help to lay the foundation for the other topics that grow outward from the main honeycomb, the source.

Figure 24: Architecture - Practical Topics

8.2: Architecture: Design Topics

All of these are overarching topics in architecture and offer a broad look into the categories that architecture encompasses. They are rather ambiguous and can be perceived differently by each person, but they help to lay out a foundation of the more specific topics that are present in architecture. In light of this, the next grouping found in figure 25 highlights some of the topics more closely linked to the aspects of design typologies that are housed under the umbrella of architecture. Again, these are not the only topics that fit in this grouping, however they are the topics that gained prominence in the discussions held at the Practicum Firm. These topics include *retail*, *education*, *commercial*, *healthcare*, and *office* uses.

Retail consists of the different buildings that facilitate the sale of goods. This includes food, clothing, and other miscellaneous merchandise. *Education* refers to any facility that has a primary focus in educating individuals with practical and theoretical knowledge that can be applied. This includes primary, secondary, and tertiary schools, as well as trade schools and other facilities intent on educating individuals. *Commercial* obviously has a more holistic view but this topic here refers to the group of buildings that operate on a non-governmental and non-private level. It is included as its own topic to highlight how it has developed such a prominence in society as a broad typology. *Healthcare* refers to any facility that helps to improve the physical, mental, and/or emotional health of an individual. *Office* refers to those environments that facilitate a collaborative work environment, frequently in the realm of commercial use. All of these begin to overlap with each other at some point, and it is important to remember that this is useful to architects. We do not want to get in a habit of fully segregating these topics because they have an ability to align gracefully with other topics outside the general framework of architecture. This level of specificity allows for a conversation of overlap or weaving to occur.

Architecture

Design Topics

These topics highlight the different questions, ideas, and needs of that are often considered or could be considered in the design process. Often these topics introduce the more specific topics in the next section.

Figure 25: Architecture - Design Topics

8.3: Architecture: Social Topics

We will look at one more main group in the discipline of architecture seen in figure 26. This group looks more at the main social topics that are addressed frequently by architects. This is perhaps the closest group to reach out to the other disciplines soon to be discussed. This group consists of the topics of *shopping, wayfinding, collaboration, workspace,* and *sleeping.*

Shopping is included because of its highly social aspect of interaction. Shopping is most closely tied to the retail aspect though it can include some of the service industry. *Wayfinding* refers to the means with which one navigates through a building or a space. Most often this includes signage or some visual/printed indicators but can also be a non-written cue that helps one find their way. *Collaboration* refers to situations where a group of people are working together towards a common goal. Frequently this is a medium sized group (2-10 people) but can expand to entire companies or social groups and can cross disciplines. *Workspace* refers to the individual space with which one works in as well as the collective spaces that are formed by a group working. The most common workspaces are found in an office environment but can be any area where men and women are working. *Sleeping* refers both to the physical area or room that one sleeps in, and also the conditions and situations where one rests and recovers; it is generally a personal space but does not have to be.

These social topics begin to introduce the opportunity of cross-disciplinary integration. They are specific enough to find unique parallels yet broad enough to allow additional ideas and needs to be introduced. As these are just a few of the possible topics in these categories, it is important to remember that more can be found and highlighted. These topics, however, hold the strongest connections with some of the other discipline's topics soon to be discussed.

Architecture

Social Topics

These topics introduce some of the possible discussions that can be had in the specific ways that architecture effects and can be affected. These are more specific topics and they present a need for a more thorough understanding.

Figure 26: Architecture - Social Topics

8.4: Neuroscience: Practical Topics

The discipline of neuroscience is not the most clearly understood discipline to the layperson. Its complexities are rooted in deep scientific thought and understanding and there is no simple way to understand all that the discipline of neuroscience covers. The architect was once considered the 'renaissance man;' one who possesses a general working knowledge of all the great disciplines and perhaps even a relative skill set in each. Through the years, this expectation for a comprehensive and exhaustive knowledge has been replaced by an opportunity to work with different consultants in various disciplines. At one point this weakens the architects skills and breadth of knowledge, but on the other hand this has helped to bolster the overall quality and complexity of architectural design by introducing true specialists in each field.

This topic of neuroscience has yet to be fully introduced to architects, though it is certainly a growing discussion in the field. With the development of the Academy of Neuroscience for Architecture (ANFA)[75] as well as various other written resources and lectures, there has been a rapid growth of interest and knowledge of neuroscience in the context of architecture. The following topics in the process web highlight some of the more pertinent topics that cater to the topics already presented in the architectural portion of the process web.

First, as seen in figures 27 and 28, this portion of the process web begins with the central honeycomb of neuroscience and then the growth of the practical topics of the *tactile*, *visual*, and *auditory* faculties. These are important to begin with because they are some of the main senses that the human body operates nearly every second of life. Taste and smell are omitted from this group because they are relatively less involved in the discipline of architecture. Although they still

[75] "ANFA | Academy of Neuroscience for Architecture." ANFA. Accessed February 27, 2015. http://www.anfarch.org/.

play a role, for the sake of focus and clarity to the discussion at hand, they will not be included right now.

Tactile refers to those things that we can touch and feel physically. This includes the wood and brick and concrete and steel as well as the trees and grass and water; all the things that make up the environment that surrounds us. In addition, this includes the processes that we go through in order to feel or touch; the various functions that our bodies operate to conduct such actions. This is certainly not a small topic. *Visual* refers to all the things that we can see with our eyes as well as those things that we can perceive. This notion of perception is somewhat complex but it has such wonderful ties in neuroscience as well as in architecture. *Auditory* refers to those things which we hear in an environment. This also includes those things that we can sense and interpret without the addition of sight or touch, another topic that is rather complex but links uniquely with architecture.

These three topics often work in conjunction to allow us to perceive the environment around us. With the next topic groups, it will be clear that they hold roots in multiple senses at a time. They are rarely independent. With much of the neurological processes, sight prompts touch, touch prompts sight, hearing focuses sight, and so on. There is a unique correlation with these three senses that we operate every day. In the next groups we will dig more deeply into some of these unique situations.

Neuroscience

Main Honeycomb

This is an overview of all the different topcis that are introduced in the web from this specific discipline. Each topic is separated into groups which will in turn begin to refer to the other disciplines included in the overall web.

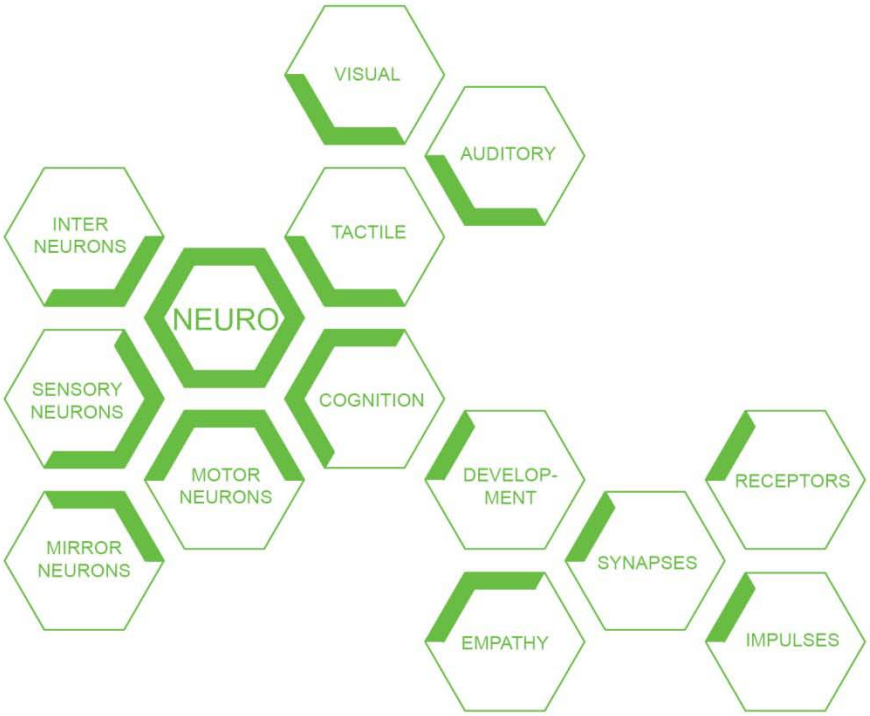

Figure 27: Neuroscience - Main Honeycomb

Neuroscience

Practical Topics

These topics consist of the more fundamental concepts, ideas, and discussions in the discipline of neuroscience. They help to lay the foundation for the other topics that grow outward from the main honeycomb, the source.

Figure 28: Neuroscience - Practical Topics

8.5: Neuroscience: Design Topics

Delving more deeply into the discipline of neuroscience we still need to maintain our potential ties to the discipline of architecture. Throughout all the various topics that could be addressed at this stage there are six that stand out as having a focus in the notion of design. As seen in figure 29, the first three deal with some of the theoretical topics and the second three look into more of the physical objects that help to transmit or facilitate these theoretical situations. The first three topics are *cognition*, *development*, and *empathy*.

Cognition refers to the process of learning. It explains how we acquire knowledge and actually understand. This notion is imperative in the topic of architecture, as anyone who uses a building must understand where they are and the purpose of the building. This does not mean that a building must have a distinct purpose but it does mean that a user will understand that building in some way. This topic is very important for architects to know so that we can design spaces that are understandable and do not confuse the user.

Development refers to the idea that the mind is constantly developing as new information is introduced. This development occurs at a much more rapid rate at the younger ages, but does continue throughout a person's life. This is important for architects in several ways; one is that there is a huge impact that the building or built environment has on how a young person or a child learns. Another reason is that even as an adult, the mind is being molded by all its outside influences, however subtle. A peaceful environment has an ability to instill peace in a person and a hectic environment can unhinge that peace. We will look at some of the specific mental faculties that are involved in this idea in the following topic group.

Empathy refers to the ability to not only understand and be able to consider the feelings of others, but to actually be able to feel the same feelings that a person is going through. If often highlights the ability to have a deep, thorough knowledge of a person or situation and not just an understanding based on a cursory knowledge. So often in architecture we discuss how a person can be sympathetic to the space that they are in and in turn we consider how a building can be sympathetic to the needs of the user. It is an interesting concept to consider if a building could actually be empathetic to a user. Perhaps that does not mean that the building has nerves and winces when someone bumps the wall, but it may mean that the design of a building can have such a deep and thorough knowledge of a person that the architecture is responsive to a person as if it could indeed feel or interpret their emotions and needs. This could be a step towards an 'empathetic' architecture! This research is interested in doing just that. With this introduction of two disciplines that work so closely with the social science of a person, an architect will now have the knowledge to anticipate the needs of a user and design architecture that is responsive to these needs and addresses them more effectively!!

The other three topics included into this group are some of the physical elements that are a part of the central nervous system and help to facilitate and control communication from the brain to the body. These three topics are *receptors, impulses,* and *synapses*. *Receptors* are molecules that collect and bind information that is received by the various senses. These then trigger the operation of *impulses*, which force electrical signals to the brain, and then back to the parts of the body for action to be taken. They flow between nerve cells with the help of *synapses*, which link these cells together; though not with a physical connection but rather a very small gap between cells. These are simplified definitions of much more complex topics, but the importance of these is the real focus. The receptors, impulses, and synapses are three tools and methods that the brain employs to take information and develop it into useful knowledge and potentially action. This action may be manifested physically or emotionally.

The reason this is important to know as an architect is that some of these cells and neurons in the body can have a profound effect on how a person perceives a space and feels in a space. If we as architects have a more thorough understanding of how some of the processes take place, we can anticipate them and design in a way that caters to their wants and needs. In the next group we will get more specific on some of these topics that can be integral to an architect's knowledge and ability to serve the user in the most successful ways possible.

Neuroscience

Design Topics

These topics highlight the different questions, ideas, and needs of that are often considered or could be considered in the design process. Often these topics introduce the more specific topics in the next section.

Figure 29: Neuroscience - Design Topics

8.6: Neuroscience: Social Topics

This next group (figure 30) deals with the different classifications of neurons. Each classification is a broad grouping of neural types and will be explained in a broad manner. The three main classifications are sensory neurons, motor neurons, and interneurons. In addition to these three classifications is the mirror neuron. This is a unique neuron that has the ability to possibly be classified under multiple groups.

The following definitions of the different neurons here will be again simplified definitions and they will be related back to the ideas and understanding of the architect. The *sensory neuron* receives information and transfers it back to the central nervous system in the body by way of the *interneuron*, which will be explained in a moment. The central nervous system is essentially the different nerves and tissues that are in the spinal cord and brain. These sensory neurons are amazing in that they are responsible for receiving any number of influences and stimuli, and beginning the transfer process back to the reasoning part of the mind. These neurons are basically the translators that bring all the important information to the attention of the brain! The architecture that we develop is perceived by these sensory neurons; they interpret the built environment for the brain to use, decipher, and apply.

The *interneuron* is a group of neurons that take the information received from the sensory neuron and ultimately bring it to the motor neuron. They are the messengers between input and output, between taking this information from the outside world and the actions of doing something about it. These interneurons make up the largest group of neurons in the human body and most of them reside in the central nervous system. These are the real 'worker bees' of the neuron groups. Once the brain takes in the information, by way of the interneurons, that the sensory neuron received, it then puts the interneurons back to work and sends new information to the motor neuron.

The *motor neuron* takes that realized information from the opposite direction. Once the sensory neurons have done their job and the interneurons have brought those inputs to the brain, new information is sent from the brain to the functioning parts of our bodies. This information, transferred by the motor neuron, tells, among other things, our muscles to contract and move and directs our bodies to carry out the physical action that our brain tells it to do. Sensory neurons take the information that the architecture is enacting upon us and the motor neurons then allow us to interact back with the architecture in any number of unique ways.

These three classifications of neurons outline the phenomenal cells in our bodies that sense, transfer, and activate information in our bodies by way of the central nervous system. This ability to sense and act is not a new concept to architects, but it is important for us to understand more thoroughly what is happening in our bodies and mind as a person interacts with the architecture that we design. It is obvious to us now that architecture has some sort of impact on a person, either positively or negatively, however a more acute sense of 'why' is the goal we are all trying to achieve. There is a certain type of neuron within the human body that might be able to crack the code of some of the questions as to why we do what we do, especially as we encounter architecture.

The mirror neuron is a specific type of neuron that will be discussed in great detail in the next chapter. This neuron has some phenomenal qualities and potential applications in the world of architecture. This neuron has qualities of both a sensory neuron and a motor neuron. In its unique qualities there are some very, very interesting possibilities. The most basic explanation of the mirror neuron is that it responds to a stimulus and attempts to mimic that sensation within the brain. This topic will be very important in the following chapter.

Neuroscience

Social Topics

These topics introduce some of the possible discussions that can be had in the specific ways that architecture effects and can be affected. These are more specific topics and they present a need for a more thorough understanding.

Figure 30: Neuroscience - Social Topics

8.7: Psychology: Practical Topics

The discipline of psychology is a vast and far-reaching discipline that covers several topics and can be included in the discussions of so many different disciplines. The integration of psychological concepts and discussions into the discipline of architecture is far from a new idea. Architects have always been interested in the psychology of a person and have given it attention as they design a building. The topics introduced in this portion of the process web do not attempt to introduce something completely new, but rather highlight some of the interesting crossovers that have evidenced themselves along the path of this research.

The definitions for each of the following topics in figure 31 may not always be the most commonly used descriptions. Instead, they will be defined in a way that can be related back to the topics found in architecture. As the focus of this entire document is to help architects be more equipped and potentially have more tools to make them better designers, each topic must nod back again to this topic of architecture.

The first group in figure 32 includes five topics that are often referred to as the "Big Five" personality traits which are based on the "five-factor model."[76] These five categories identify the main personality traits that an individual might possess and by which they might be understood by. There has been hearty debate as to the accuracy and usefulness of these five personality traits. Some have argued that the traits don't even address personality while others argue that some traits ought to hold a higher importance than others. Regardless of the arguments it is clear that these topics certainly exist and with such an attention to them in the field of psychology it was important to add them.

[76] Raad, Boele De. "Introduction." In The Big Five Personality Factors: The Psycholexical Approach to Personality, 3. Kirkland, WA: Hogrefe & Huber, 2000.

These five topics go by slightly different names from time to time so here they are laid out with the intent that they will be tied back into the ideas of architecture. The five topics in this group of the process web are *agreeableness, conscientiousness, extroversion, openness to experience,* and *emotional stability.*

The first topic, *agreeableness* could be thought of as the personality trait that enables us to get along well with other people. "The agreeableness dimension is probably the most concerned with interpersonal relationships." Also, "Agreeableness enables individuals to cope with problems associated with communal living."[77] The idea that a person's personality is agreeable can relate to the idea of group collaboration and public spaces in architecture. There is a constant question in architecture as to how people will interact with each other in an architectural space.

The next topic is outlined as *extroversion*. This topic also includes the personality trait on the other side of the spectrum, introversion. "Extraversion is the outward turning of psychic energy towards the external world, while Introversion refers to the inward flow of psychic energy towards the depths of the psyche."[78] Another way to look at it is that a person who is extroverted is likely to me more outgoing, engaging, and will probably enjoy larger groups of people and not be afraid of trying new experiences. One who is introverted is more likely to enjoy seclusion, privacy, quiet environments and will probably enjoy more one-on-one interactions. It is important to note here that it is rare that a person is purely introverted or purely extroverted; most people fall on somewhere in between the two extremes of the spectrum. It is important for an architect to remember this because even though someone may enjoy large crowds or instead enjoy their own personal space in a building, we cannot assume this is their opinion all the time. A proper knowledge of this personality trait can help

[77] Raad, Boele De. The Big Five Personality Factors: The Psycholexical Approach to Personality, 91. Kirkland, WA: Hogrefe & Huber, 2000.
[78] Ibid., 88.

inform our design decisions, especially in the discussion of how people use the space in a building.

Next, "Conscientiousness, is the trait that has been drawn upon as a main psychological resource in situations where achievement is an important value..."[79] The topic of *conscientiousness* tends to highlight the idea that the stronger this trait manifests itself in a person, the more driven, focused, and capable they are. As with all of these traits, this is not a guarantee or an absolute, but there is a strong likelihood that a highly conscientious person will be more independent. This is important for an architect as they understand that each person will experience and interact with a specific building differently and those who are much less conscientious may struggle to navigate through a building. Or perhaps they are not as comfortable in a large space that has very little clearly defined uses; they may feel like they are at a loss to understand how they ought to use the space.

The terms *emotional stability* and *neuroticism* are often used interchangeably, depending on the situation. Often, emotional stability is referred to in a positive light while neuroticism is used more frequently to highlight a negative or deficiency. Someone who exhibits emotional stability will often be more reasonable, can adapt to changes more comfortably, and can control their emotions more effectively. One who might be classified as having neurotic tendencies "sometimes show a characteristic, maladaptive, helplessness style that prevents them from functioning effectively."[80] In addition to these traits being relatively difficult to identify and understand with any level of precision, it is also difficult to design a space that can accommodate such a personality trait. This trait may help an architect consider the level of confusion they are interested in introducing in their design. Sometimes a very rational and structured design might help those who are uncomfortable or unable to function amidst a seemingly changing environment.

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[79] Raad, Boele De. The Big Five Personality Factors: The Psycholexical Approach to Personality, 93. Kirkland, WA: Hogrefe & Huber, 2000.
[80] Ibid., 95.

Intellect, also referred to as *openness to experience*, has been a highly debated trait among experts in the field. Some feel it is not linked directly with personality, but for the sake of this discussion we will include it as it is part of the 'Big Five' personality traits. There are many contexts with which this trait could be linked, but we'll look at one here. "In the contexts of learning and education, Openness to Experience has been related to learning strategies."[81] There are many ways in which a mind can retain and recall information but often a person develops a strategy of learning and memorization that they are most comfortable with. If however, they are willing to attempt a new learning strategy, they might develop an even stronger ability in this capacity. The idea is that a strong openness to experience could lead to a stronger ability in functional and reasoning capacities in their life. This is important for an architect to consider because architecture has the ability to introduce people to a new method of use or paradigm of thought. It can present a new way of thinking or living or interacting and with a knowledge of how people are or are not open to experience, could help them design a space that reflects a person's ability in this capacity.

These are some of the 'broad brush' topics that the discipline of psychology holds. Now we can look more specifically into some other topics.

[81] Raad, Boele De. The Big Five Personality Factors: The Psycholexical Approach to Personality, 97. Kirkland, WA: Hogrefe & Huber, 2000.

Psychology

Main Honeycomb

This is an overview of all the different topcis that are introduced in the web from this specific discipline. Each topic is separated into groups which will in turn begin to refer to the other disciplines included in the overall web.

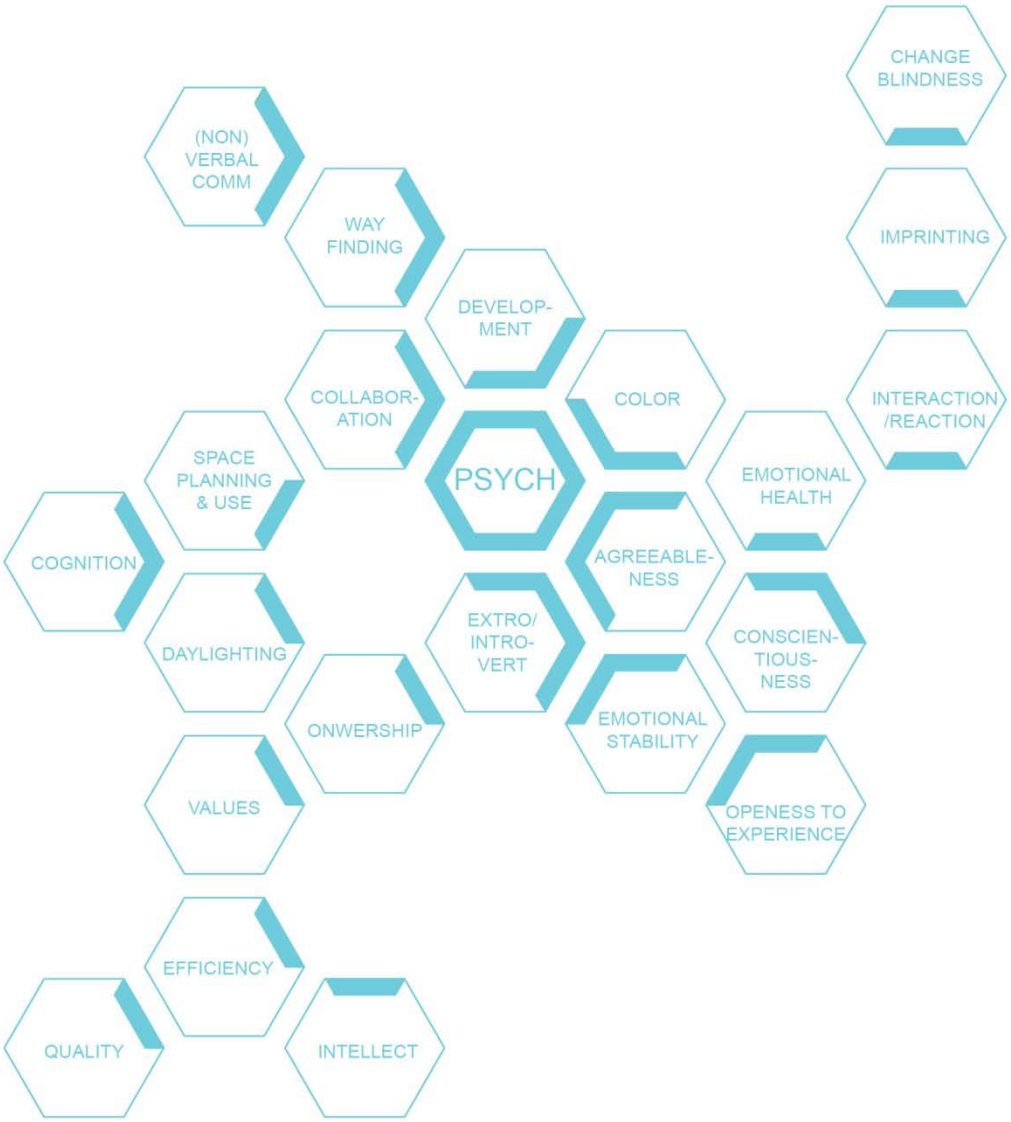


Figure 31: Psychology - Main Honeycomb

Psychology

Practical Topics

These topics consist of the more fundamental concepts, ideas, and discussions in the discipline of psychology. They help to lay the foundation for the other topics that grow outward from the main honeycomb, the source.

Figure 32: Psychology - Practical Topics

8.8: Psychology: Design Topics

The next group in figure 33 looks at some of the topics that could be more important as an architect is developing their design. These topics look at some of the main ways that a person might interact with the architecture. They are *collaboration, development, emotional health, interaction/reaction, color, imprinting,* and *change blindness.*

Collaboration refers to how a person interacts and works with a group of people. This could be working on a specific task with a selected team or simply interacting with a group of people without a specified task in mind. *Development* refers to how a person develops over the course of their life mentally, emotionally, and physically. The majority of this development happens at a young age, however it also continues throughout their lifetime. *Emotional health* refers to the general well-being of a person and a special emphasis could be placed here to highlight how they feel within a building or a space that an architect has designed. This could include a single interaction or a series of interactions that occur over repeated visits to the building, often if it is a job or school. *Interaction/reaction* refers here to how a person might interact or experience a space and then what their reaction might be. This could include physical or emotional reactions. These topics highlight some of the ways that a person might experience or enjoy or dislike a space, often over an extended period of time.

Color refers to the larger topic of color theory and how a person experiences and reacts to different colors and color sequences within a building. This is a widely discussed and researched topic that can greatly help an architect as they design their buildings. *Imprinting* refers to a situation where a person learns something and that action or habit remains with them for a very long period of time, sometimes an entire lifetime. Also, once something is imprinted, outside or different behavior rarely has any impact, as the imprinted habit remains. This is important to an architect because the first impression or experience that a person has with a building might imprint upon them a certain

impression that they will always have when returning. *Change blindness* refers to the idea that a person is not fully aware of subtle or even bold changes in their environment. If a sign says a certain thing, then in changed overnight, even if someone walks past that sign every day, they may not notice that there was a change.

Psychology

Design Topics

These topics highlight the different questions, ideas, and needs of that are often considered or could be considered in the design process. Often these topics introduce the more specific topics in the next section.

Figure 33: Psychology - Design Topics

8.9: Psychology: Social Topics

The last group in figure 34 looks at another set of topics that looks more closely at how a person might actually use a building. These topics are *wayfinding, daylighting, nonverbal communication, space planning and use, ownership, cognition, values, efficiency, quality,* and *intellect.*

Wayfinding refers to how a person navigates through a building. This may be by intuition, wandering, or visual or audible cues that help to direct them. *Daylighting* refers to the amount or duration of natural light that enters a building. This topic is important because certain users may want or need a specific type of lighting. Museums and homes usually need a different type of daylighting.

Nonverbal communication refers to the way in which a person communicates without speech or other widely recognized communication methods such as sign language. Often nonverbal communication is performed by body language, gestures, and facial expressions. An architect might be able to develop a building to 'communicate' to a person in a similar manner; whether it be the form of a building, the material choices, lighting, or any other number of techniques. It is important for an architect to understand how common and frequent nonverbal communication happens in a single interaction.

Space planning and use refers, not to the architect's task, but rather how a person develops their own space within a pre-established building. We need to remember that even once a building is built, changes go on so that a person is more comfortable in their specific space. This also presents the topic of *ownership*, which refers to how a person develops or does not develop a sense of ownership in a building or space depending on the different interaction and adaption factors that are available in a space. It is important to understand how different user groups develop ownership in different architectural typologies.

Cognition refers, not simply to the way that a person learns, but specifically here how a person comes to understand a building and become comfortable with it on some level. If we can be clearer on how a person perceives a space and develops an understanding of where they are, we can design a space that is more easily understood or accepted. Or perhaps we could design it to be less understood, whatever the need of the building may be. One example of that would be the way a prison, or perhaps a courthouse, is designed. Some buildings need a level of complexity in them to separate different user groups.

Values refer to the different set of factors to which a person attributes a higher or lower level of importance. Users in one architectural typology may have a vastly different set of values, or architectural needs, than users in another typology. Understanding what types of people have stronger values in different categories could greatly aid decision making in the design process. *Efficiency* refers to the user's perception as to the usefulness or efficiency that a space offers. Some spaces may facilitate more rapid and effective production or use while other spaces may stint progress if they are designed poorly.

Quality refers to the way that a person perceives quality in architecture. Some are more attentive to material and construction quality, others are more interested in the quality of a space; how useful it is or is not. Some are interested in the quality of lighting or acoustics, and others with the quality of navigational clarity. *Intellect* here refers to the idea that a person can understand a space and appreciate it or not. This is not precisely referring to their IQ but rather how well a person can understand architecture. Some people struggle understanding the layout of a building, while others are able to move through it almost intuitively. Others can understand and appreciate a form and it speaks to their soul. Others aren't interested or able to even consider why one form was chosen over another.

As an architect, all of these topics become very necessary to understand. the psychological processes that a person operates are broad and powerful; it is important that we as architects can come to a more thorough understanding of these topics so we can serve the needs better. These are just some topics that found prominence in this research, there are certainly more that could be considered.

Psychology

Social Topics

These topics introduce some of the possible discussions that can be had in the specific ways that architecture effects and can be affected. These are more specific topics and they present a need for a more thorough understanding.

Figure 34: Psychology - Social Topics

8.10: Architecture: Neuroscience Crossovers

The different topics that have been addressed and defined in the disciplines of architecture, neuroscience, and psychology are some of the main points that became prominent in this research. There are additional topics that could be added to this web to an almost infinite level. Now you have a beginning process web to utilize as you consider the additional topics that can be pertinent to your architectural designs.

Each topic that was defined was a brief overview of much more complex ideas. They require more personal research and understanding in order to most effectively employ the knowledge of the topics in your own personal design process. This is the bounding board, the starting point that can help to get you moving in the right direction. I encourage you to use this process web as a resource to reference during your investigative steps in your design process. Graphically you can see how some of these topics begin to relate to each other and through the body of text you have a broad understanding of each topic.

In the next group of figures, we will look at some of the strongest crossovers that can be made between each discipline and define them with a bit more depth. This will simulate how you could use this process web to extract the most pertinent topics that apply to your specific design process. You can then take the topics that you extract and delve more deeply into them via your own personal research. This process web outlines the topics and general definitions and opens the door for you to take each topic further.

In the discipline of neuroscience, there are several topics that have a strong relevance to the discipline of architecture. Some of the topics highlighted in figure 35 are *visual, tactile, development, empathy,* and *mirror neurons*. These topics are being highlighted to show how these crossover connections can be made by an architect and some of the ideas that could be researched further.

As stated previously, *visual* refers to all the things that we can see with our eyes as well as those things that we can perceive. Practically, the visual sense is a rather simple one. We see those physical things in front of us, we deduce their importance, and we move on. However when we begin to consider how our visual sense can help us perceive a space, especially those things which are not obvious, we can develop a stronger appreciation for this neurological quality. Our minds take the information that is received through the eyes but they don't just simply turn that information into ones and zeros as if it were a simple binary code. Rather our minds then cluster our visual input with our other sensory inputs, our past experiences, and our inferences with what could possibly happen in the future.

All of this information, spliced together seamlessly, begins to inform us as to how we ought to feel, operate in, and experience a space. As an architect, knowing how our mind ranks our visual input and then how it integrates it in with the other senses and variables should inform our design decisions. We may learn that certain spatial organizations have a unique and perhaps severe impact on the visual harmonies for a person. We may learn that other colors, shapes, or angles frequently have a soothing effect which could help in educational environments or medical offices. When we can integrate the neurological foundation for vision into our designer's attention, we will see the needs of the user with a stronger clarity.

Tactile refers to those things that we can touch and feel physically. Every time a person walks into a building, they are touching the floor, even if it's through their shoes. They grasp a doorknob, flip a switch, move a chair, lean against a wall, or press open a window. These are all nearly subconscious operations that a person goes through nearly every time they are in a building. What if these experiences had a profound effect on the person? Well, they do. Every person perceives a texture, a temperature, or an object differently. Some are very callous and indifferent and others have a heightened sensitivity to these actions of touch.

Take, for example, an individual who is autistic. This person has an extremely heightened level of sensitivity in many categories of their lives, often highlighted in their senses. The sense of touch for those who are autistic can trigger a wide range of reactions. Rough, highly textured surfaces often incite a strongly negative reaction; extreme discomfort, burning sensations, and even piercing sounds can be perceived when coming in contact with a stucco wall. Perhaps we as designers can take this into consideration when designing an elementary school when those who are autistic are first learning to integrate more smoothly into group environments. This might inform our choice of wall covering to a more smooth or soft texture. Similarity, we might know to design more comforting group spaces, as those who are autistic often are uncomfortable in group situations. A proper understanding of how the tactile experiences effect and influence an individual can be very helpful to an architect.

The idea of *development* is a very big topic in the discipline of neuroscience. How the brain develops, how the personality develops as a result, even how the body develops is important to understand. One of the big discussions within the topic of development is of course outside factors. The environment that a person finds themselves in on a day to day basis can have a strong impact on the way that they develop. Although development is more pronounced at younger ages, the mind continues to develop throughout life, even if it's in small stages. As an architect, it is important to know what factors influence development the most, and how the buildings that a person operates in has an impact. A person lives, learns, sleeps, works, plays, and relaxes in architecture. A huge amount of a person's life is spent in some type of building, therefore it is imperative that we develop a stronger understanding on how a building can encourage or restrict development in a person.

Empathy is another very broad topic that could offer some very unique opportunities for an architect. The ability to not only intellectually understand but also mentally and emotionally relate and even feel the same thing that a person is going through is a huge skill to have. Is there a way to develop a building that

is empathetic to a person's needs? This is a complex question that likely doesn't have a proper answer yet, however these are the types of things that an architect could benefit from by using the expertise of a neuroscientist. With a more in depth understanding of what empathy is in the mind and how it occurs, it could help an architect design a building that employs similar techniques of empathetic attention.

Finally, *Mirror Neurons* are those cells that could actually help us as architects more deeply understand empathy, sympathy, development, and more. As this topic will be addressed more thoroughly in the next chapter we will leave the description at that for now.

Architecture

Neuroscience Crossovers

This highlights the topics that architecture either has a clear influence on or has some level of interest in. These topics could potentially be beneficial to the discipline of architecture.

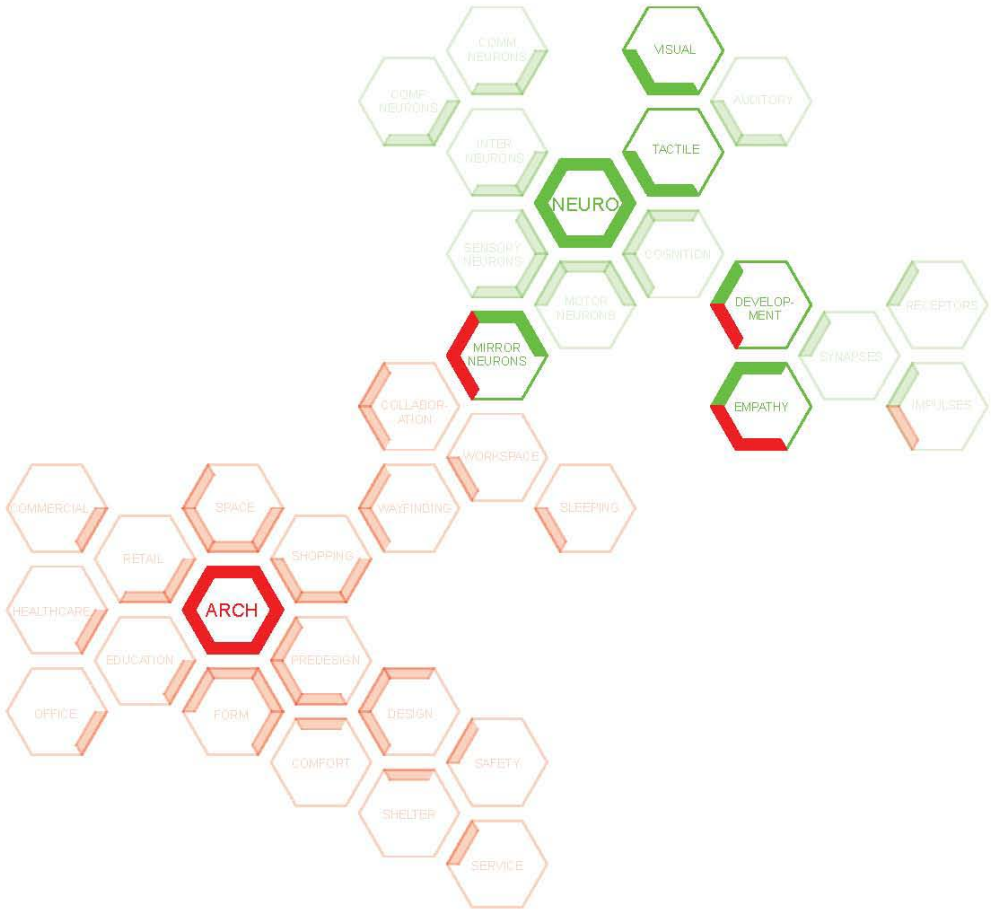


Figure 35: Architecture - Neuroscience Crossovers

8.11: Architecture: Psychology Crossovers

In the discipline of psychology, a great number of crossovers can be made; we will look at four specifically here in figure 36. They are *ownership, collaboration, wayfinding,* and *non-verbal communication.* Each of these has a vast body of research compiled, and actually there is quite a bit of research already linking these topics with the field of architecture. The biggest need in this case is for an architect to be reminded of their simple definitions and that these topics are indeed very important for an architect to know. As before, these topics will be laid out with a level of information that can help us know where to start looking should we decide to dig further.

Ownership again refers to how a person develops a sense of ownership or connection with a building. A sense of ownership can be developed in a number of different ways but it often includes the ability for a person to change or adapt a space to fit their personal needs. Often, if a person has the ability or even the perception of being in control of their immediate surroundings, they will establish a more personal connection with that space. If a person has the ability to adjust the temperature, daylight, sound level, or general collection of items in their immediate surroundings, then they will be more likely to feel comfortable and at ease in that space. As an architect we need to keep in mind how a person might adapt a space to their unique and personal needs once they occupy a space. Often a person who uses a space every single day will find the most suitable organization of items in a space for some specific purpose.

Collaboration is a key component in most architectural settings. It refers to the situation where a group of people are gathered together for a common purpose. This could be simply to lounge and relax or to work together on a complex and demanding problem. Regardless of their activity, the effective nature of collaboration is critical in these situations. If we as architects can understand the psychological underpinnings of how a person enjoys working in groups and what they need to accomplish their goals, we can design a space

that accommodates their needs. This may be useful in education, workspace, or even retail settings. These options are seemingly endless and it is up to each individual designer to take the knowledge of these disciplines and apply it in their own, intelligent way.

Wayfinding refers to how a person navigates through a space. As stated previously, this may be by intuition, wandering, or visual or audible cues that help to direct them. Often, the most common method of helping a person find their way in a building is by the use of signage. Another topic mentioned earlier, change blindness, reminds us that the signage in a building might not be recognized, especially if there are changes or updates. As a designer, we cannot rely simply on the use of signage to ensure that a person can navigate a building. If we can understand more properly how a person orients themselves spatially, how they perceive the path and goal while navigating, and how they come to conclusions as to how to progress through a space, we can design spaces and collections of spaces that help them move through them intuitively. This is another fascinating topic that requires more personal research, but look how useful this knowledge of the psychological perspective can aid us.

Finally, *non-verbal communication* refers to all the ways that a person communicates and acknowledges communication without the use of verbal or sign language. One interesting component of non-verbal communication is that it does not have to happen solely between two people. A building can actually have an effect on a person's ability to understand a space and therefore be more comfortable in it. If the form of a building is hectic with unnatural angles and stark contrasts, a person might understand this as a communication method, encouraging them to feel more energetic or even confused in a space. This very well may be the intention of the design but if it is not then there is a need to reconsider the design of the form. Every part of a building, even the texture on the doorknobs has the ability to, and often does, communicate something to a person. We need to understand more deeply the different ways that a person

communicates and perceives communication in order to make sure we are telling them what we intend to tell them with our designs.

All of these different topics would be necessary to be more precisely researched and understood before intelligent and successful design solutions could be comfortably employed, however, we now have a more clear vision as to some of the important topics that we can hold in our mind as we're progressing through our design process.

Architecture

Psychology Crossovers

This highlights the topics that architecture either has a clear influence on or has some level of interest in. These topics could potentially be beneficial to the discipline of architecture.

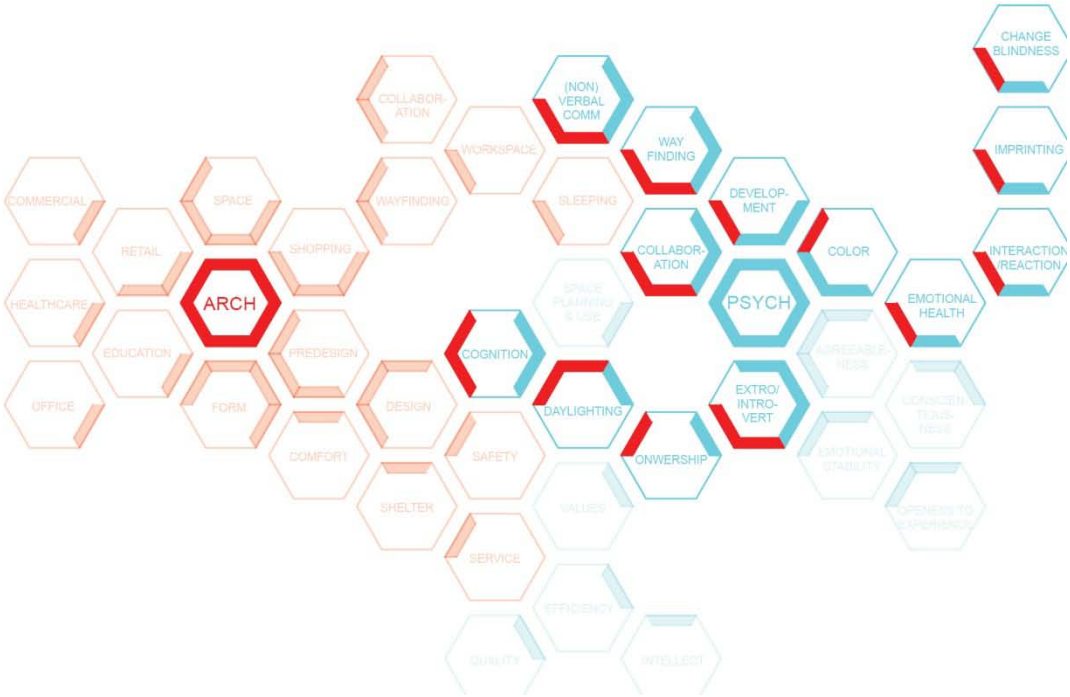


Figure 36: Architecture - Psychology Crossovers

8.12: Major Crossovers

Here is one more technique that can be employed by using this process web. In figures 37 and 38, we can see that some of the connections that were made in our previous discussions actually have a fairly consistent level of overlap between all three disciplines of architecture, neuroscience, and psychology. These topics, addressed individually, have a very strong relevance to architectural designers. However, if we look at some of them used in conjunction, we can see how they can complement each other and give an even stronger perspective to the usefulness to designers. Figure 39 shows how some of these topics could be grouped to offer an even more thorough education to us as architects.

This technique is a recommendation; there are many other combinations that may be useful depending on the specific nature of the design problem that you are working through. The main thing to take away from this portion of the process web is that each topic that has been presented should not be simply looked at individually or in a vacuum. Each one of these topics has a strength on its own, but the true strength of this knowledge base is that there are a number of topics that work together to educate us on the qualities of the neuroscientist's and psychologist's points of view.

As we move into the next chapter, we will look into one of these topics, mirror neurons, more thoroughly. The purpose of this is to show you how we can pull a topic out of this process web and explore how it can be useful to an architect. As we look into what a mirror neuron is we will also look at some specific examples of how that knowledge can be applied to the architectural design process. This is the final purpose of the document - to show the actual application of one of the topics presented it the process web. In addition to this, I have found the topic of mirror neurons to be so useful to a designer that it is important to introduce it now so it can be applied in design right away.

Major crossovers

Strongest Connections

These are the main topics that cross most strongly between the three disciplines. This helps the architect understand that in the context of this process web, these are the topics that can be researched further and likely can add great understanding to the architectual design process.

Figure 37: Major Crossovers - Strongest Connections

Major crossovers

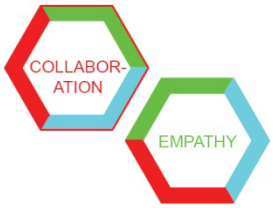
Strongest Connections

These are the main topics that cross most strongly between the three disciplines. This helps the architect understand that in the context of this process web, these are the topics that can be researched further and likely can add great understanding to the architectual design process.

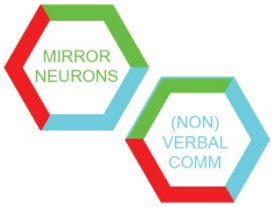
Figure 38: Major Crossovers - Strongest Connections Enlarged

Major crossovers

Strongest Connections



Collaboration and empathy have a strong connection. Understanding how people work together and also how they understand and feel another's emotions and needs can be critical in design. These topcs can inform each other and then be interepreted and applied in an architectural design. Both concepts on their own are strong but together they introduce a level of thought that could trigger great understanding for the architect.



Mirror neurons and non-verbal communication tend to go hand in hand. The mirror neuron is responsible for some level of communication and how a person perceives that communication is often in a way that does not employ speech. A designer can splice these concepts together to apply appropriately in their design. The function of the brain and the resulting personality actions should be in the forefront of a designer's thoughts.

Figure 39: Major Crossovers - Strongest Connections Detailed

Conclusion

This document has brought to our attention several concepts. The goal of this research was to make the topics of psychology and neuroscience more accessible to architects, and show how an in-depth understanding of one or more topics within these other disciplines can aid the design decisions of an architect. Through an application of some of the topics presented, I believe that an architect will have the ability to more effectively apply certain topics within the fields of psychology and neuroscience in their own personal process of design.

After looking at why these topics are important to architects, as well as psychologists and neuroscientists, we looked at some of the possible gaps that exist within the architectural design process that can be aided by these other disciplines. With this we looked at a wide range of different topics these disciplines had to offer, and looked much more closely at one topic: mirror neurons.

I believe that the knowledge of how mirror neurons operate, as well as several ideas of how their usefulness can be applied to the architects design process, is very valuable information. Mirror neurons open the door to so many possibilities within the focus of architectural design. Understanding how we can trigger or stimulate these neural responses in the users can aid our quest to design buildings that are more comfortable, understandable, and enjoyable.

Mirror neurons and their applicable properties are still being heavily discussed in the discipline of neuroscience and therefore I expect that we will be introduced to additional properties and applications of these neurons that have not been considered yet. The body of work here is limited in the fact that the topic of mirror neurons is also quite limited, but I feel that is the ideal time to be focusing on such a topic! If architects can tap into this resource as the ideas are still being developed, there is a greater opportunity for new discoveries in mirror neurons to occur in conjunction with, or even because, of architectural exploration.

In the future, the process web laid out in this document could be developed further, including expounding on the topics presented here, as well as other topics that are pertinent to the work of an architect. Ideally, a process web could be developed for each topic to the depth that the mirror neuron topic has been developed.

I believe that this research can be the catalyst for architects to see and understand differently the way a person operates. This concept of architecture triggering reaction on a psychological level and especially a neurological level can push architects to think much more critically about the way they design. I believe that mirror neurons hold the key to a more thorough understanding of empathy, comfort, and understanding. Since everyone in the world comes in contact with architecture, It is imperative for architects to see this link and investigate how they might properly apply this new knowledge into the way they design.

Appendix

Ofsted
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Dane Court Grammar School

Inspection report

Unique Reference Number	118932
Local Authority	Kent
Inspection number	291290
Inspection date	6 June 2007
Reporting inspector	Robert Ellis HMI

This inspection of the school was carried out under section 5 of the Education Act 2005.

Type of school	Grammar (selective)
School category	Foundation
Age range of pupils	11–19
Gender of pupils	Mixed
Number on roll	
School	776
6th form	341
Appropriate authority	The governing body
Chair	Virginia Austin
Headteacher	Paul Luxmoore
Date of previous school inspection	5 March 2002
School address	Broadstairs Road Broadstairs CT10 2RT
Telephone number	01843 864941
Fax number	01843 602742

Age group	11–19
Inspection date	6 June 2007
Inspection number	291290

[82]

[82] Ofsted Inspection Report 2007 - Dane Court Grammar School
http://danecourt.kent.sch.uk/parents8/reference/downloads/inspection-reports

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Introduction

The inspection was carried out by one of Her Majesty's Inspectors and one Additional Inspector.

Description of the school

Dane Court is a selective grammar school with a sixth form that is part of the Thanet Sixth Form Consortium. The school has specialist status for languages. It draws most of its students from a large number of primary schools from across the Isle of Thanet, which is an area of social and economic deprivation, and most students are from White British backgrounds. The proportion of students entitled to free school meals is below the national average. The percentage of students speaking English as an additional language is below average, as is the proportion of students who have learning difficulties or disabilities. The school has been designated by the local authority as a special educational needs resource base for two students who have visual impairment.

Key for inspection grades

Grade 1	Outstanding
Grade 2	Good
Grade 3	Satisfactory
Grade 4	Inadequate

Overall effectiveness of the school

Grade: 1

The school provides an outstanding education for its students. It has improved significantly over the last few years and now has outstanding provision in most areas.

Students join the school in Year 7 with standards that are above the national average but lower than those seen in many selective schools. Standards of attainment at the end of Key Stage 3 are high and students' achievement is outstanding. Results in GCSE examinations in 2006 were also high, but slightly below the average for selective schools. Standards are rising and, given their starting points, the students' achievement overall is outstanding.

Personal development and well-being are outstanding because the school has a very inclusive ethos and students' spiritual, social, moral and cultural development is outstanding. Students enjoy learning and feel that they are safe and well cared for because care, guidance and support are outstanding. They say that they enjoy lessons and have good relationships with their teachers and other students. Most students have positive attitudes to learning and their behaviour is outstanding. The number of students excluded from the school is very low because it has very good procedures for supporting students at risk of exclusion. Attendance is well above the national average for secondary schools.

The curriculum is good. It allows most students to choose courses that meet their needs and interests and is enriched by a broad range of activities which are designed to develop skills, confidence and self-esteem. The school's specialist language status has had a notable impact in this respect. However, access to vocational options is limited. Teaching is generally of a high quality and many lessons are outstanding. However, senior leaders recognise that a small proportion of teaching does not yet meet the school's exacting standards. Students, including those in the sixth form, say that they receive outstanding guidance and support which enables them to achieve very well and prepare for the next stages in their education.

Almost all parents are supportive. The majority feel well informed about their children's progress, and value the educational opportunities which the school provides. Parents particularly value the care and support that their children receive when they join the school.

The school is exceptionally well led and managed. The leadership of the headteacher is outstanding. The senior leadership team has a clear vision for the future of the school and high expectations of what can be achieved. Senior leaders monitor the work of the school extremely well and have an accurate picture of its strengths and areas for development. The school makes good use of the restricted accommodation available but the poor quality of many classrooms limits the type of activities that can be undertaken in lessons.

Effectiveness and efficiency of the sixth form

Grade: 1

The school provides an outstanding quality of education for its sixth-form students. Standards achieved by students at the end of their sixth-form courses are similar to those achieved in other selective schools, and most students achieve challenging targets. Most take advantage of what is offered and become mature and confident young adults. Teaching in the sixth form is generally of a high standard and in almost all subjects, students are enabled to make outstanding progress.

Most Year 11 students remain at the school to continue their education. The curriculum meets the needs and interests of all students and the range of courses is broad and is enhanced by the school's participation in the local sixth-form consortium. However, only a relatively small number of students take advantage of courses offered at the other schools in the consortium.

There are good opportunities for students to take responsibility and to contribute to the life of the school, particularly through the house system and as prefects. Sixth-form students are generally good role models and many are involved in activities to support younger students. Advice, guidance and support are outstanding and sixth-form students speak very positively about their experiences and appreciate the additional time and effort that their teachers give to enable their learning and development. Leadership and management of the sixth form are outstanding.

What the school should do to improve further

- improve the accommodation to provide a good environment for learning
- provide students with a greater choice of vocational options.

Achievement and standards

Grade: 1

Grade for sixth form: 1

The attainment of students when they enter the school at the beginning of Year 7 is not as high as is seen in many selective schools. Students achieve extremely well in Key Stage 3. In 2006, results were significantly above the national average, and improving, and these students made outstanding progress in relation to their starting points.

GCSE results are also significantly above average and improving, and almost all students achieved the equivalent of 5 A* - C grades in 2006, with 97% achieving 5 A* - C including mathematics and English. Analysis of the school's data demonstrates that most students achieve challenging targets.

There are no significant differences in the achievement of different groups of students, including those who have learning difficulties or disabilities, visually impaired students and those who do not speak English as a first language.

Personal development and well-being

Grade: 1

Grade for sixth form: 1

Students' personal development, including their spiritual, moral, social and cultural development, is outstanding. In class, their mature and thoughtful attitudes to learning enable them to make excellent progress. Their sensible and considerate behaviour around the buildings and the site make the school a safe and civilised place to be. Students enjoy coming to school very much indeed, and this is reflected in their high attendance rates.

Students have a good understanding of how to lead a healthy lifestyle. They value the many opportunities they have to take part in physical education and appreciate the healthy foods available at break and lunchtime. Students feel secure and confident at school. They have excellent relationships with staff and are happy to turn to them if they have problems. 'Pretty much any teacher is willing to listen to you', said one. Students have a sense of commitment to the school community, and those who have special responsibilities, such as school councillors

and house prefects, take their roles seriously and carry them out with enthusiasm. Thanks to the very high standards they reach in literacy and numeracy and their excellent social skills and opportunities to learn about the world of work, including opportunities for international work experience in the sixth form, students are very well prepared for moving on to the next stage in their lives.

Quality of provision

Teaching and learning

Grade: 1

Grade for sixth form: 1

Teaching and learning are excellent overall across the school, and this enables students of all ages to make outstanding progress. Typically, lessons are very carefully planned to meet students' learning needs, with the emphasis on pace and challenge, so that students are inspired and motivated to learn as well as they can. Teachers focus very successfully on developing students' independence, while at the same time encouraging their teamworking skills, so that their confidence and maturity grow in leaps and bounds. Resources are well chosen to interest and stimulate students, and particularly good use is made of information and communication technology (ICT). Teachers have consistently high expectations for behaviour, which means students feel well supported and able to learn. In the few lessons where teaching and learning are less than good, the pace of work is not always well planned to match the range of ability within the group, and management of activities is sometimes ineffective.

Most teachers make good use of assessment to plan their lessons and organise their groups so that students are given work at the right level to help them achieve as well as they can. Students are grateful for the feedback they receive on their work and understand what they need to do to improve.

Curriculum and other activities

Grade: 2

Grade for sixth form: 2

The school's curriculum is good. All subjects are well covered and students get an excellent grounding in literacy, numeracy and ICT skills across the curriculum so they are very well prepared for their future. Students have good opportunities to choose their subjects from a wide range of academic options for GCSE and A level. However, the school recognises that their access to vocational courses is limited. Enrichment of the curriculum, through clubs, events, trips and visiting speakers, is outstanding. Thanks to the school's language college status, for example, students enjoy the chance to travel abroad and take part in exchange visits regularly. During the inspection, a Bavarian band was performing at the school as part of the international programme of cultural and linguistic activities. Students are very enthusiastic about the range of sporting, musical, and other activities which they are able to try out, and the take-up for these activities is very high.

The school's specialist language college status is having a positive impact on achievement by encouraging an increased use of ICT as a teaching and tracking tool and for developing students' independence. It is also raising the profile of the school in the local community through the outreach work to develop modern foreign language teaching, which the school does with eleven local primary schools.

Care, guidance and support

Grade: 1

Grade for sixth form: 1

Adults at all levels are committed to promoting health and safety and encouraging students' enjoyment and achievement. Arrangements for safeguarding students are rigorous and effective. Students are set challenging targets and their progress towards those targets is closely monitored. However, the monitoring systems are still being developed and refined and are not yet used to full effect in all departments. Students who are at risk of underachievement and those who need additional support are identified, and intervention programmes put in place to address their needs. Students say that they feel very well supported and that they know who they can go to if they need help or support. The school has developed good partnerships with parents and other agencies to ensure that students are extremely well cared for and enabled to make outstanding progress.

Leadership and management

Grade: 1

Grade for sixth form: 1

Leadership and management are outstanding. The senior leadership team has made good progress in developing a positive ethos, raising achievement and improving provision. The headteacher and his senior team have a clear vision for the school's future. Those responsible for leading and managing the school at all levels have a detailed and accurate knowledge of its strengths and areas for development. All aspects of the school's work are closely monitored and thorough analysis of the information gathered is used to target actions to remedy any weaknesses that are identified. The positive impact of the actions already taken to bring about sustained improvement demonstrates an excellent capacity for further improvement.

The nature of the buildings and the layout of the site provide challenges to collaborative activities between subjects. The school makes good use of its limited accommodation and has planned to refurbish some buildings and demolish and redevelop others.

The governing body is well informed and has an accurate view of the school's achievements. Governors provide good support for the school and monitor its progress carefully.

Any complaints about the inspection or the report should be made following the procedures set out in the guidance 'Complaints about school inspection', which is available from Ofsted's website: www.ofsted.gov.uk.

Annex A

Inspection judgements

Key to judgements: grade 1 is outstanding, grade 2 good, grade 3 satisfactory, and grade 4 inadequate	**School Overall**	**16-19**

Overall effectiveness

How effective, efficient and inclusive is the provision of education, integrated care and any extended services in meeting the needs of learners?	1	1
How well does the school work in partnership with others to promote learners' well-being?	1	1
The effectiveness of the school's self-evaluation	2	2
The capacity to make any necessary improvements	1	1
Effective steps have been taken to promote improvement since the last inspection	Yes	Yes

Achievement and standards

How well do learners achieve?	1	1
The standards[1] reached by learners	1	1
How well learners make progress, taking account of any significant variations between groups of learners	1	1
How well learners with learning difficulties and disabilities make progress	1	

Personal development and well-being

How good is the overall personal development and well-being of the learners?	1	1
The extent of learners' spiritual, moral, social and cultural development	1	
The behaviour of learners	1	
The attendance of learners	1	
How well learners enjoy their education	1	
The extent to which learners adopt safe practices	1	
The extent to which learners adopt healthy lifestyles	2	
The extent to which learners make a positive contribution to the community	2	
How well learners develop workplace and other skills that will contribute to their future economic well-being	1	

The quality of provision

How effective are teaching and learning in meeting the full range of the learners' needs?	1	1
How well do the curriculum and other activities meet the range of needs and interests of learners?	2	2
How well are learners cared for, guided and supported?	1	1

[1] Grade 1 - Exceptionally and consistently high; Grade 2 - Generally above average with none significantly below average; Grade 3 - Broadly average to below average; Grade 4 - Exceptionally low.

83

[83] Ofsted Interim Inspection Report 2011 - Dane Court Grammar School http://danecourt.kent.sch.uk/parents8/reference/downloads/inspection-reports

Annex A

Leadership and management

How effective are leadership and management in raising achievement and supporting all learners?	1	1
How effectively leaders and managers at all levels set clear direction leading to improvement and promote high quality of care and education	1	
How effectively performance is monitored, evaluated and improved to meet challenging targets	2	
How well equality of opportunity is promoted and discrimination tackled so that all learners achieve as well as they can	1	
How effectively and efficiently resources, including staff, are deployed to achieve value for money	2	
The extent to which governors and other supervisory boards discharge their responsibilities	2	
Do procedures for safeguarding learners meet current government requirements?	Yes	Yes
Does this school require special measures?	No	
Does this school require a notice to improve?	No	

Annex B

Text from letter to pupils explaining the findings of the inspection

7 June 2007

Dear Students

Inspection of Dane Court Grammar School, Broadstairs, CT10 2RT

Thank you for making us feel so welcome, and a special thank-you to those of you who spoke to us about your school, particularly the sixth form students who gave up some of their revision time to talk to me.

After having considered all the evidence, we judged your school to be outstanding.

We were impressed by your friendliness and how well you look after the school and each other. You told us that you enjoy being at school and feel safe and well looked after. You are well represented by your school council and have a say in what happens in your school. We were pleased to see that you understand the need to adopt healthy lifestyles and have very positive attitudes to learning.

The people who have responsibility for making decisions about your school know it really well and have a clear understanding of what it does best and what needs to improve.

There are many areas of the school's work that are already outstanding but there are two things we think could be better.

Your school needs to develop the curriculum so that there are more vocational options for you to choose from and it needs to move forward with the planned developments to the site, so that you have better spaces to learn in. You can help by continuing to support the school and playing your part in its continuing improvement.

Thank you again for helping us with our work and making our visit to Dane Court so enjoyable.

Robert Ellis Her Majesty's Inspector

PROTECT – INSPECTION

Aviation House
125 Kingsway
London WC2B 6SE

T 0300 123 1231
enquiries@ofsted.gov.uk
www.ofsted.gov.uk

Ofsted
raising standards
improving lives

12 July 2010

Dane Court Grammar School
Broadstairs Road
Broadstairs
Kent
CT10 2RT

Our reference:118932

Dear Parent

Dane Court Grammar School: Ofsted's interim assessment

I am pleased to provide some important information about Dane Court Grammar School.

As you may know, during its last inspection in, Ofsted inspectors judged your child's school to be outstanding. Schools which are performing well are now inspected less often than other schools.

Some outstanding schools are inspected after three years; others may have their inspections put back. To help decide whether we can wait longer than three years before undertaking a full inspection of an outstanding school, such as your child's, Her Majesty's Inspectors look at various sources of information, as listed below. This is called an 'interim assessment.'

The results of the interim assessment

In carrying out the interim assessment, we considered the following:

- pupils' academic performance
- pupils' attendance
- any visits carried out by Ofsted since the last inspection
- complaints about the school by parents or carers
- any other significant issues brought to Ofsted's attention.

I am pleased to inform you that our interim assessment shows that the school's performance has been sustained and that we can defer its next full inspection

As a result, the next full inspection will not take place any earlier than 1 September 2011 unless we receive information in the course of the coming year that causes us

to inspect earlier. The timing of subsequent inspection will depend on any changes that the government will introduce in legislation in the autumn.

I wish everyone involved in the school continued success in the coming year.

Yours sincerely

Christine Gilbert

Department for Education

School and college performance tables

Performance Tables School details

Find a school by Postcode 1 mile Find Schools/Colleges

England South East Kent

Selected schools/colleges (3)
Remove this school from your selection

Dane Court Grammar School

last update : (31 Jan 2015)

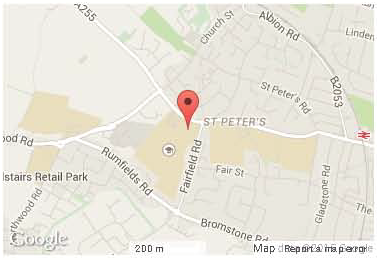
School details

last update : (29 Jan 2015)

Street	Broadstairs Road
Town	Broadstairs
Postcode	CT10 2RT
Telephone number	01843 864941
Headteacher/Principal's name	Mr Paul Luxmoore
Age Range: lowest age	11
Age Range: highest age	18
Gender of entry	Mixed
School type	Academy - Converter Mainstream
Current admissions policy	Selective
Denomination	None
Unique Reference Number	136585
School published in KS2 tables	No
School published in KS4 tables	Yes
School published in KS5 tables	Yes

Confirmation that school has checked its data (Secondary)	Yes
Confirmation that examination information checked (16-18)	No

Total number of pupils on roll (all ages)	1192
Percentage of boys on roll	44.5%
Percentage of girls on roll	55.5%
Percentage of pupils with SEN statement or on School Action Plus	1.8%
Percentage of pupils with English not as first language	7.8%
Percentage of pupils eligible for free school meals	5.6%
Percentage of pupils eligible for FSM at any time during the past 6 years	12.4%



External links

View Local Authority website

Ofqual

Downloads

Download full set of school data CSV
CSV, 66352 bytes

Download full set of school data XLS
XLS, 103936 bytes

Funding Agreement
PDF, 19.84 Mbytes

Annual Report and Financial Statements 2012-2013
PDF, 10.93 Mbytes
Scanned PDF supplied by the academy trust. To enquire about a version for users of assistive technology click here

Value For Money Statement 2012-2013
PDF, 83087 bytes

Similar Schools (Key Stage 4)
To compare this school's performance against similar schools click here

2014 KS4 Performance Tables

last update : (29 Jan 2015)

indicates where there is a graph available by clicking on the symbol

Cohort information

Number of pupils at the end of KS4	175
Key Stage 2 APS of cohort	31.1

	Number in cohort	Percentage of cohort
Low attainers	0	0%
Middle attainers	43	25%
High attainers	130	75%
Pupils for whom English is not their first language	13	7%
Pupils with statements or supported at	6	3%

84

[84] Performance Tables 2015 - Dane Court Grammar School
http://www.education.gov.uk/cgi-bin/schools/performance/school.pl?urn=136585

school action plus		

Year on year comparisons

Percentage achieving 5+ A*-C GCSEs (or equivalent) including English and maths GCSEs	2011	2012	2013	2014
School	94%	92%	94%	90%
LA	59.4%	61.3%	63.1%	58%
England - All Schools	59%	59.4%	59.2%	53.4%

KS4 exam results

	All pupils	Low attainers	Middle attainers	High attainers
Percentage achieving 5 A*-C GCSEs (or equivalents) including English and maths GCSEs	90%	NE	81%	93%
Percentage achieving A*-C in English and maths GCSEs	91%	NE	81%	94%
Percentage of pupils achieving the EBacc	62%	NE	40%	69%
Percentage of pupils achieving 5+ A*-C grade GCSEs (or equivalent)	97%			
Percentage of pupils achieving 5+ A*-G grade GCSEs (or equivalent)	100%			
% of pupils achieving any qualifications	100%			
Number of KS4 pupils with entries in all EBacc subject areas	142	NE	31	109
Percentage of pupils with entries in all EBacc subject areas	81%	NE	72%	84%

KS4 pupil progress

	All pupils	Low attainers	Middle attainers	High attainers
Percentage of pupils making expected progress in English	79%	NE	77%	79%
Percentage of pupils making expected progress in maths	90%	NE	81%	92%
Best 8 value added	1015.5	NE	1025.0	1012.3
Lower confidence limit	1004.6	NE	1003.2	999.8
Upper confidence limit	1026.4	NE	1046.9	1024.9
Percentage of pupils included in VA measure	99%			

KS4 Average Point Scores

	All pupils	Low attainers	Middle attainers	High attainers
Total average (capped) point score per pupil	388.5	NE	358.1	398.2
Average grade per qualification		NE	B-	B+

KS4 Exam entries

	All pupils	Low attainers	Middle attainers	High attainers
Average entries per pupil - all qualifications	10.7	NE	10.2	10.8

Disadvantaged Pupils

	Disadvantaged pupils	Other pupils
Number of Pupils	19	156

Percentage of Pupils	11%	89%
Percentage achieving grades A*-C in English and maths GCSEs	89%	91%
Percentage achieving 5+ A*-C GCSEs (or equivalent) including English and maths GCSEs	89%	90%
Percentage of pupils making expected progress in English	84%	78%
Percentage of pupils making expected progress in maths	89%	90%
Best 8 VA measure	1002.9	1017.0
Best 8 VA lower 95% confidence limit for disadvantaged pupils	969.1	1005.4
Best 8 VA upper 95% confidence limit for disadvantaged pupils	1036.7	1028.5
Average entries per pupil - all qualifications	10.5	10.7
Average point score per pupil (best 8) - all qualifications	374.6	390.2

For the purposes of the table Disadvantaged pupils are considered as those eligible for free school meals and children looked after (ie, in the care of the Local Authority for at least 6 months)

2014 16-18 Performance Tables last update : (29 Jan 2015)

Cohort Information

Number of students aged 16-18	330
Number of students at the end of KS5 study	129
Number of students at the end of A level study	12
Number of full-time equivalent students at the end of A level study	5.2
Number of students at the end of academic study	107
Number of full-time equivalent students at the end of academic study	101.7
Number of students at the end of vocational study	34
Number of full-time equivalent students at the end of vocational study	27.3

A level Attainment

Average point score per A level entry	203.3
Average point score per A level entry expressed as a grade	C-
Average point score per A level student (full-time equivalent)	703.8
% of A level students achieving at least 3 A levels at A*-E	0%
% of A level students achieving at least 2 A levels at A*-E	50%
% of A level students achieving AAB or higher in at least 2 facilitating subjects	0%

A level Progress

Value Added score	-0.23
Lower confidence limit	-0.65
Upper confidence limit	0.20
Number of A level entries	12

Academic Attainment

Average point score per academic entry	193.5

Average point score per academic entry expressed as a grade	D+
Average point score per academic student (full-time equivalent)	1007.2
% of academic students achieving qualifications equivalent to at least 3 A levels at A*-E	84%
% of academic students achieving qualifications equivalent to at least 2 A levels at A*-E	93%

Academic Progress

Value Added score	0.03
Lower confidence limit	-0.11
Upper confidence limit	0.18
Number of academic entries	103

Vocational Attainment

Average point score per vocational entry	247.7
Average point score per vocational entry expressed as a grade	Dist*-
Average point score per vocational student (full-time equivalent)	562.0
% of vocational students achieving at least 3 substantial vocational qualifications	6%
% of vocational students achieving at least 2 substantial vocational qualifications	71%

Vocational Progress

Value Added score	0.48
Lower confidence limit	0.23
Upper confidence limit	0.73
Number of vocational entries	32

Pupil Absence last update : (11 Dec 2013)

	School	England - national (secondary state-funded)
Overall absence: percentage	5.0%	5.8%
Persistent absence: around 15% +	2.8%	6.5%

Please note - this year the Department will publish full year 2013/14 absence data in the performance tables in March 2015 rather than just the autumn and spring term data in December as in previous years, and we will continue to do so in future years. This is because the full year data provides the most robust indication of school absence rates.
School level information for the 2013/14 autumn and spring term only is available in our Statistical First Release here

2013-14 Finance last update : (29 Jan 2015)

No 2013-2014 Consistent Financial Reporting data (see the guidance)

School Workforce last update : (29 Jan 2015)

This data is based upon the November 2013 School Workforce Census

	School	England - national (secondary state-funded)
Headcount of all teachers in a school	86	227957
Headcount of all teaching assistants in a school	10	68901
Headcount of all support (exc. auxiliary) staff in a	21	89346

school		
Full-time equivalent number of all teachers in a school	79.6	211533.0
Full-time equivalent number of all teaching assistants in a school	5.4	53876.9
Full-time equivalent number of all support (exc. auxiliary) staff in a school	18.6	74423.5
Ratio of pupils to teachers in a school	15.0	15.0
Average gross salary of all teachers in a school	39902	38521

Ofsted Inspection last update : (31 Jan 2015)

Inspection date	06 June 2007
Inspection outcome	1
Web link	Link to Ofsted inspection report

Education Destination Measure for 2011/12 cohort last update : (31 Jan 2015)

	School	England - national (secondary state-funded)
Number of pupils	170	561800
Total in a sustained education destination	96%	88%
Further Education College	11%	34%
Independent School	2%	SP
Other Further Education Provider	2%	3%
School Sixth Form	81%	37%
Sixth Form College	0%	12%
Specialist post-16 institution	0%	SP
Pupil Referral Unit or Other Alternative Provision	0%	SP
Special School	0%	1%
Apprenticeships	4%	4%
UK Higher Education Institution	0%	SP
Education combination	0%	SP
Education destination not sustained	4%	7%
Activity not captured in data	0%	4%

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