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Human Use of Computers Framework: Assessment Using the Computer Procrastination Problem

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Abstract

As more and more human living involves interacting with various computer systems, it becomes increasingly important to understand the full picture of what is involved in such computer use. Without such an understanding, we will be limited in our ability to either design systems and practices which maximize benefit and human flourishing, or to recognize, understand, and address dysfunction where it occurs. Basden's (2008) Human Use of Computers Framework provides a structure for considering many facets of computer use. Based on the philosophy of Herman Dooyeweerd, Basden's framework considers computer use as the simultaneous functioning of a.) humans interacting with the computer, b.) engaging with the content, and c.) living with computers in their everyday lives. Each of the three categories of functioning can be analysed in each of Dooyeweerd's 15 aspects of reality. This framework is a promising structure for providing rich understanding, but its ability to provide useful insight had not been tested or verified. The original contribution to knowledge of this thesis is an assessment of the framework and a demonstration that it does indeed provide insight when used to analyse various computer use situations, including complex or problematic situations. It demonstrates this through an analysis of the problem of computer procrastination, which makes a suitable test case because it is complex, interdisciplinary, and understudied. In addition, the thesis extends the framework by providing an understanding of how normativity and responsibility flow between the simultaneous functionings.

Keywords

human-computer interaction, computer procrastination, philosophy of technology, information systems

Disciplines

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THE HUMAN USE OF COMPUTERS FRAMEWORK: ASSESSMENT USING THE COMPUTER PROCRASTINATION PROBLEM

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When your tool is a hammer, all of your problems begin to look like nails.

– attributed to Abraham Maslow

I do not understand my own actions. For I do not do what I want, but I do the very thing I hate. ... But in fact it is no longer I that do it, but sin that dwells within me. For I know that nothing good dwells within me, that is, in my flesh. I can will what is right, but I cannot do it. For I do not do the good I want, but the evil I do not want is what I do. Now if I do what I do not want, it is no longer I that do it, but sin that dwells within me. So I find it to be a law that when I want to do what is good, evil lies close at hand. For I delight in the law of God in my inmost self, but I see in my members another law at war with the law of my mind, making me captive to the law of sin that dwells in my members. Wretched man that I am! Who will rescue me from this body of death? Thanks be to God through Jesus Christ our Lord!

– St. Paul's letter to the Romans 7:15-25,
New Revised Version

Dedicated to Jenni, of course.

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DECLARATION

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Breems, N. S. (2012, April). *Towards an understanding of computers and procrastination: A philosophical approach.* Paper presented at the meeting of the International Institute for Development and Ethics Annual Working Conference, Maarssen, The Netherlands.

Breems, N. S. (2011, August). *A philosophical investigation of computers and procrastination.* Paper presented at the meeting of the Christian Philosopher's Conference 2011, The Free University, Amsterdam, The Netherlands.

Breems, N. S. (2011, July). *Computers and procrastination: "I'll just check my Facebook quick a second"*. Paper presented at the International Association for Computers and Philosophy 2011 International Conference, University of Aarhus, Aarhus, Denmark.

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ACRONYMS

AIP	Adult Inventory of Procrastination
CLI	Command Line Interface
CPU	Central Processing Unit
EMC	Engaging with Meaningful Content
ERC	Engaging with Represented Content
FFU	Framework For Understanding
GPS	General Procrastination Scale
GOMS	Goals, Operators, Methods, and Selection rules
GUI	Graphical User Interface
HCI	Human-Computer Interaction
HLC	Human Living with Computers
HUCF	Human Use of Computers Framework
IADQ	Internet Addiction Diagnostic Questionnaire
IAT	Internet Addiction Test
I/O	Input/Output
ITAUT	Unified Theory of Acceptance and Use of Technology
NWRIU	Non-Work-Related Internet Use
PEOU	Perceived Ease Of Use
PIU	Problematic Internet Use
PU	Perceived Usefulness
TAM	Technology Acceptance Model
TPB	Theory of Blanned Behaviour
TRA	Theory of Reasoned Action
UI	User Interface
WIMP	Windows, Icons, Menus and Pointers

A NOTE ON ACRONYMS Throughout this thesis, the first time an acronym is used in any given chapter, the full definition will be used; thereafter, the abreviated form will be used. The first use of any acronym in each paragraph will be in SMALLCAPS, as a reminder to the reader that the full definition is available in this glossary, and in the digital version of this thesis it is hyperlinked back to this glossary. Each additional use of the acronym in that paragraph will be in normal type. The exception to this will be HUCF, HCI, EMC, and HLC, which, by the end of Chapter 3 ought to be sufficiently familiar that for the remainder of the thesis, they'll generally appear in acronym form in normal type.

ABSTRACT

As more and more human living involves interacting with various computer systems, it becomes increasingly important to understand the full picture of what is involved in such computer use. Without such an understanding, we will be limited in our ability to either design systems and practices which maximize benefit and human flourishing, or to recognize, understand, and address dysfunction where it occurs. Basden's (2008) Human Use of Computers Framework provides a structure for considering many facets of computer use. Based on the philosophy of Herman Dooyeweerd, Basden's framework considers computer use as the simultaneous functioning of a.) humans interacting with the computer, b.) engaging with the content, and c.) living with computers in their everyday lives. Each of the three categories of functioning can be analysed in each of Dooyeweerd's 15 aspects of reality. This framework is a promising structure for providing rich understanding, but its ability to provide useful insight had not been tested or verified. The original contribution to knowledge of this thesis is an assessment of the framework and a demonstration that it does indeed provide insight when used to analyse various computer use situations, including complex or problematic situations. It demonstrates this through an analysis of the problem of computer procrastination, which makes a suitable test case because it is complex, interdisciplinary, and understudied. In addition, the thesis extends the framework by providing an understanding of how normativity and responsibility flow between the simultaneous functionings.

1

INTRODUCTION

1.1 BEING HUMAN WHILE USING COMPUTERS

In my work as a computer professional, and then throughout the completion of my Master's degree in computer science and beginning career as a post-secondary instructor, I have struggled with an uncomfortable tension. I enjoy using computers, and at a deeper level I am convinced that developing appropriate and useful computer technology is a meaningful response to our human calling. But at the same time, I've come to regard the role that computer technology plays in our society with some wariness.

This wariness stems from the observation that my students, users, and society at large appear to accept most computer applications without much critique or evaluation. This worries me, because like any technology, new computer applications are never neutral. They always contain embedded within them the values of the choices made in their design. As Postman (1993) phrases it: "Embedded in every tool is an ideological bias, a predisposition to construct the world as one thing rather than another, to value one thing over another, to amplify one sense or skill or attitude more loudly than another" (p. 13).

And, of course, these embedded values don't remain inert, but the inherent tendencies and predispositions come out in the way the technology is used. Thus, while many computer applications serve very appropriately as tools for improving various aspects of our lives, we also know from experience that there are other applications and uses of computer technology which do not clearly result in benefit but rather get in the way of meeting our goals in the large sense. Without sufficient critique and evaluation we are likely to confuse these two kinds of situations, resulting in a subtle but significant detriment to full human flourishing.

Although many of the built-in tendencies of the computer come to fruition at the large scale of systemic effects on society, I am convinced that computer technology presents at least as much challenge to the individual human heart, prodding and pulling at us to be more like it – more mechanical and algorithmic, more abstract. My goal then, has been to work towards a strategy for realizing the rich potential of computing power to assist us in our goals – and indeed, to liberate us from many kinds of drudgery – but to do so in a way that doesn't further imbalance the way we live. Indeed, truly normative computer technology can help restore balance by allowing and encouraging us to be whole, integrated, and authentic human beings.

1.1.1 *The Founding Question*

This then, led to the main motivating question behind much of my research, "*How can we stay fully human in the face of computer technology?*" Embedded within this question are the assumptions that there is such a thing as "fully human", that this is a desirable goal to strive for, and that at least some forms of computer technology can have a tendency to make that goal-striving more difficult.

This question is, by itself, unsuitable for focused academic study, being much too broad and vaguely defined. However, it does provide a useful springboard for thought, giving rise to other, more specific questions that have meaningful human impact. So, having arrived at this overall foundation question, I began to search for approaches to understanding computer technology that could help address these issues.

1.2 DISCOVERY OF BASDEN'S HUMAN USE OF COMPUTERS FRAMEWORK

This foundational question led me to search for existing ways of thinking about the activity of human computer use, and the impacts we invite and allow the computer to have in our lives. Only within the context of examining the human use of computers can the larger questions of staying fully human be asked. Many such approaches fit under the umbrella of Human-Computer Interaction research. The field of Human-Computer Interaction (HCI) consists of a large collection of inter-related disciplines. "To a considerable extent, HCI now aggregates a collection of semi-autonomous fields of research and practice in human-centered informatics" (Carroll, 2014). What most of these fields have in common is an emphasis on the cognitive factors (Karvonen et al., 2010). Other approaches to understanding the human use of computers, including a wide variety of organizational-centric studies of the effects of information systems on businesses, are surveyed in Chapter 2.

However, as will be discussed in the next section and in Section 2.3, these lenses are too narrow to provide a comprehensive view of all that transpires during the human use of computers, and thus cannot provide a suitable platform for reasoning about how to shape the impacts that computers have in our lives. An approach to understanding computer use that relies on philosophical tools can be helpful in providing a broad view.

I was previously familiar with and appreciative of the philosophy of Herman Dooyeweerd (1955–1958), and in particular, his famous ontology of aspects, which is useful for highlighting overlooked or hidden aspects of a situation. I thus investigated approaches to understanding computer use that built on this foundation. Works by scholars such as Schuurman (1995)and Monsma et al. (1986) use Dooyeweerd's philosophy to understand the human activity that is technology. However, while these resources can provide a solid philosophical basis for considering technology in general, they are much too abstract and general to provide much practical guidance on questions related to computer use in particular. As will be seen in the next section, the issues that arise in the everyday experience of using computers are diverse and occupy a wide spectrum of palpability, from highly abstract to very concrete.

I then found Basden's (2008) philosophical framework for understanding human use of computers. This framework is described in Chapter 3. It has an explicitly everyday concern, which makes it a good fit for understanding the diversity of issues that come up in computer use, as experienced by the user, and reasoning about the relationship of the user to the technology itself, and the impacts that this has. This use of "everyday" is explored and compared to other similar concepts in Section 3.1.2.

Basden's framework is built on a Dooyeweerdian foundation, and in particular on Dooyeweerd's 15 modal aspects introduced in Section 3.3. While it would be theoretically possible to rebuild Basden's framework on a different set of aspects, this would be unwise for two reasons: First, Basden's use of Dooyeweerd is integral and extends beyond the use of Dooyeweerd's aspects. Thus, to switch out Dooyeweerd's conception of aspects for another suite would risk subtle but irreparable damage to the rest of Basden's Human Use of Computers Framework. Second, Dooyeweerd's aspects are expressly developed for addressing the everyday human experience of life, with Dooyeweerd spending significant time in his *New Critique* (1955–1958) identifying the diversity of meaning everyday experiencing and ensuring that the identified aspects are philosophically sound. This attention to "naïve pretheoretical experience" (1955–1958, p. 3) gives everyday experience a dignity that is rare in philosophy, and makes a Dooyeweerdian foundation very helpful for addressing the diversity of meaning encountered in computer use.

A second benefit that results from the frameworks philosophical foundation is that there is a basis for both critique and modification of the framework, but within boundaries that ensure the revised framework will maintain internal consistency. This means that the framework can be evaluated according to its own criteria, and improved in ways that respect those criteria. All of this means that the framework is compelling, in the sense that it shows significant promise to be helpful in understanding the human experience of computer use and the impacts of that use. This is, however, not good enough. The question of whether or not it keeps that promise must be investigated before it can be relied upon to produce important insights into the nature and impacts of computer use. The framework, as presented by Basden in his 2008 book, has not yet been evaluated or assessed. Thus, the work of this thesis is to provide this assessment, verifying the framework's utility at producing fruitful insight, and also improving upon it.

1.3 THE DIVERSITY OF COMPUTER USE

Understanding what happens when a human uses a computers involves considering a vast range of issues. Consider the example of a graphic designer in a company's marketing department composing an advertisement. All of the following issues are at play simultaneously:

- While she tends not to think of it during use, she is a physiological being, and the ergonomic fit of her body to the chair, desk, keyboard, mouse, and screen affects her comfort, productivity, and long-term health.
- She is only one member of the department, and is using artwork from one colleague and ad copy from another. She retrieves these files over the network, and sometimes finds that someone has edited the artwork after she imported it without consulting her. Both of her colleagues

deny doing this. Interpersonal relationships within the office have been tense as a result.

- Her employer has provided her with a powerful computer to assist with the graphics-intensive computing she does. They are expecting that her increased productivity will result in a return on that investment, increasing their overall profit.
- She enjoys using most of the programs on her computer, but finds that one of the "plug-ins" used with her photo-editing software is baulky and difficult to use, which saps the joy of using it significantly.
- When she takes a short break and checks her Facebook, she is immersed in the content and feels more "present" with her far-flung friends than she does in the office.
- She has a clear picture in her head of the final result she would like to achieve, but is rather "fuzzy" regarding the details of how the images and text she's working with are stored in and manipulated by the computer.
- Many of the impacts and consequences of her computer use are the expected and desired ones – well-designed and visually appealing advertising materials produced economically. However, other consequences of her computer use may be unintended, indirect, or hidden. Extra enjoyment of her work or being able to share materials and techniques with colleagues across the country were not part of the justification for using the computer to perform her tasks, but are happy side effects of that decision. Unfortunately, not all indirect and hidden consequences are so benign. Back pain from poor posture, a narrowing of her vision of what is possible to fit the constraints of her software, and ubiquitous distraction of the possibilities on the internet are also part of the computer use situation that need to be accounted for.

- The policies and regulations in place during use – both organizational and governmental – are at play during computer use. Legal consequences for her actions, as well as the notions of justice and fairness to all parties must be part of the consideration of a full picture of computer use. The easy availability of pirated or illicit materials online poses an unethical temptation for many users.
- The well-being of the environment is at stake in computer use, even when the user is not consciously considering that aspect. The manufacture of modern computers involves many substances and processes, several of which are toxic. The rapid cycle of obsolescence in the computer industry makes recycling and disposal of old computers an important topic. The computer also uses electricity in operation which frequently comes from greenhouse-gas-releasing power sources.
- Her supervisor has been increasing the work demands on her, and she feels powerless to negotiate more fair workload expectations without jeopardising her employment. The centralised nature of the provision and administration of the computer systems seems to her to reinforce this power imbalance.

We can see that there is great diversity of issues which need to be addressed to understand the complete picture of computer use. Not only are the issues of diverse types, but the kinds of consequences and repercussions are varied as well. When considering normativity and issues of benefit and detriment, it is necessary to reason about many different ways in which good and bad results can be experienced.

Because of the significant diversity of issues, insight into problems that arise in everyday use of computers comes from a similarly wide variety of research areas, each of which employs its own theories, models or frameworks for understanding the activity taking place. Most commonly, researchers examine the computer use situation within the confines of a particular discipline, in which they analyse the situation using their own disciplinary lens, and create theories which explain what they observe.

This focused approach is crucial for providing deep insight into the particular issues which need to be considered. However, it is also perilous because such a disciplinary view can unintentionally guide developers, practitioners, and users towards the assumption that the studied aspects of the problem are the only ones that matter, leading them to ignore other meaningful perspectives which could provide key insight.

For example, the study of computer's effects on business outcomes is important, with significant benefits gained in understanding how to better design and use information systems to provide a reasonable return on investment for businesses and organisations. However, if we look only at the economic bottom line in isolation, and do not also consider other ways of thinking about the computer use situation, such as environmental impact, social relationships, power relationships, intellectual effort, or emotional affect, valuable insight from these other areas will be missed, and actions or decisions made on the basis of such research may be sub-optimal. To fully exploit the abilities of computer technology to contribute to human flourishing, we must understand the entirety of the computer use situation.

In order to understand the big picture of computer use, a number of larger frameworks for understanding have been used. Some of these are formal systems, intentionally created to address understanding computer and information system use, while others have emerged organically or informally from within communities of practice. Examples of the former include approaches to understanding IS use such as the Technology Acceptance Model (Davis, 1989), or DeLone and McLean's model of information systems success (DeLone & McLean, 1992). Examples of the second include approaches to understanding computer use based on cognitive or organizational psychology, and the picture of human computer use that emerges from research into HCI.

However, for reasons that will be explored in Section 2.3, most of these existing approaches suffer from narrowness. There is always some facet of the computer use situation that is being overlooked, whether that is an understanding of the computer technology itself, the content or the application domain of the software being used, or the human life being impacted by use of the computer.

1.3.1 *The Need for an Integrative Framework*

Complex, everyday issues that arise in computer usage cannot be addressed using narrow theoretical models, because of the wide range of ways in which each situation is meaningful. For example, a theory of computer use which explains variations of usage levels in terms of the utility which the software provides will be unable to provide much insight into playing a computer game; to think of playing a game in terms of its *utility* requires us to shift the meaning of that word so dramatically that the original theoretical model is useless. In this example, any everyday computer use situation which might involve both productivity and gaming applications would need a broader framework for understanding its use.

Various narrow theories and models for understanding computer use by humans certainly provide valuable insights, but an understanding of a contextualized computer interaction in its full “everydayness” requires a single, unified *framework for understanding* which is sensitive to such complexity and variety of meaning. Analysis performed using such a framework has the potential to integrate numerous extant approaches to the problem and provide insight into overlooked facets of the problem.

As Mitcham (1994) states:

> In undertaking an analysis of diverse types of technology, however, one cannot just dive in. The rich complexity of the subject forces one to adopt at least a provisional classifying or categorizing scheme. Numerous frameworks or preliminary typologies have been proposed and used – although these have often been more for technical, historical, encyclopedic, or educational and heuristic than philosophical purposes (p. 154).

1.3.2 *How to Assess a Framework*

"A Framework For Understanding (FFU) an area is a way of seeing an area" (Basden, 2008, p. 11). It is the conceptual apparatus we use to think with, and influences how we classify things, what kinds of theories we develop, how we formulate these theories, what methodologies we use to perform our research, what we see as important, what kinds of questions we ask, and what we see as problematic. Basden (2008) points out that "an FFU cannot be proven either correct or incorrect by theoretical means because it is held as a pre-theoretical commitment, as a set of beliefs and assumptions about the area" (p. 13).

That is, because of the nature of a framework as a set of pre-theoretical beliefs and assumptions, it makes no sense to talk about whether or not the framework is *true*. Rather, what we ask of a framework is that it be *fruitful*. A framework is a tool for insight, and when it is put to work, it ought to produce useful insights. Thus, as will be argued in Section 4.1, testing a framework requires its application to a difficult problem to see whether, indeed, fruitful insight emerges.

1.4 PROCRASTINATION

Assessing a framework for understanding requires its application to a suitable problem. Computer procrastination is the main problem chosen in this research, and some of its characteristics that make it suitable are outlined here. A fuller discussion is found in Section 6.2. Computer procrastination occurs when a computer user intends to perform some action using a computer system, but voluntarily delays actually carrying out that action, substituting some alternate activity, despite expecting to be worse off far that delay. As will be seen in Chapter 6, this behaviour is highly complex, with a rich diversity of interactions and human functioning contributing to it.

1.4.1 *Finding the Procrastination Problem*

Like many post-graduate students, I found that progress on completing my degree was frequently hampered by procrastination, and some simple time-logging and introspection showed that almost all of that procrastination took place when I sat down at the computer to write, and found myself, minutes or hours later, engaged in other computer activities (frequently, but not always, internet-based) which were not contributing to my forward productivity. This was despite my best intentions of staying on task. Informal conversations and social media interactions (see Section 6.2.3.2 for one example) quickly convinced me that this was a common computer use experience, and might well be worth studying.

Confronted with a difficulty in coming to grips with the nature of my own behaviour when using the computer at the same time that I was analysing a framework for understanding computer use seemed a serendipitous opportunity for exactly the kind of "real world" test of the framework that I was looking for. I performed an Human Use of Computers Framework (HUCF)

Primary Analysis (a technique defined in Section 4.5.1) on a particular use situation I was experiencing, and was surprised by the aspectual and functional richness that was uncovered. Computer procrastination is a deeply complex behaviour, with many irreducible and interacting aspects that need to be understood in an integrated fashion.

In addition, it is poorly understood, as it seems to fall between disciplinary boundaries, as will be shown in the next section and in Chapter 6. As will be argued in Section 4.4.1, a problem makes a good candidate for testing the framework if it is complex, poorly understood, and problematic. The issue of computer procrastination appears to meet those criteria, and is thus worth further investigation.

1.4.2 *Existing research into computer procrastination*

I began searching for literature on this topic, and while there is significant research on closely-related phenomena, the actual issue of computer procrastination (as defined in Section 6.2.2) is almost entirely overlooked in the research literature, as demonstrated in Section 6.4. This is surprising, because the anecdotal, non-scholarly discussion of this topic is quite extensive. For examples, see blog entries by Johnson (2011), Klosowski (2012), or Mnookin (2007), and anti-procrastination software *LeechBlock* (Anderson, 2013) or *StayFocusd* (Benedetto, 2012). Thus, in addition to understanding and addressing the problem of computer procrastination, I also wanted to understand why it is under-researched.

The field of psychology was the natural place to start looking for research into this area, since it is the area in which general procrastination is most studied. This literature review is summarised in Section 6.4.2. Apart from a single study by Lavoie & Pychyl (2001), the specific issue of computer-related procrastination is entirely ignored by this field.

Literature on problematic internet use or internet addiction, summarised in Section 6.4.6, deals with the problem of addictive-type behaviour, in which the user of the computer has lost conscious control of their activities, with major and pervasive negative impacts across all areas of life. As argued in Section 6.4.6.1, this is a distinct problem from procrastination because procrastination has smaller overall life impact in those who are tempted by it than full-scale internet addiction, but affects a much larger portion of the population.

The other perspective through which the larger field of psychology sees the issue of non-productive computer use is the organisational psychology area of Non-Work-Related Internet Use. Summarised in Section 6.4.5, this field is an extension of previous work in workplace deviance, and makes the similar assumption that behaviour is under the employee's rationally-chosen voluntary control. As demonstrated in Section 6.4.5.1, this area was not able to sufficiently cover the topic of computer procrastination for several reasons.

Computer procrastination is thus a behaviour which, in terms of psychology research, falls between the cracks of Problematic Internet Use (PIU), in which the behaviour is compulsive and pathological to the point of requiring clinical intervention, and workplace deviance research, which primarily assumes that the behaviour is entirely the result of rational, voluntary choice.

If the human science of psychology can't help us to fully understand the nature of computer-specific procrastination, perhaps we can appeal to fields which specifically study the use and impact of computer technology, such as Information Systems research and Human-Computer Interaction. Within information systems research, I found that the sub-field of user acceptance investigates how and why users come to use a particular form of technology. In particular, the Technology Acceptance Model (Davis, 1989) has been proven to have significant explanatory power, and is frequently referenced when attempting to understand a particular use of information technology.

For reasons explored in Section 6.4.4.1, Technology Acceptance Model (TAM) is not able to explain computer procrastination, however.

And, while HCI research should be an excellent place to investigate a problem like procrastination in principle, in practice it tends to adopt a much more task-oriented approach which often ends up rendering procrastination invisible to it because the procrastinatory activity is an entirely separate task than the one being studied. HCI research does investigate closely related concepts such as attention and user affect, however.

1.4.3 *Finding Insight in the procrastination problem*

Anecdotally, when I talk about my research with friends and colleagues, the topic of computer procrastination is the part that resonates most strongly. When I describe a scenario of sitting down at the computer to accomplish a task and then finding yourself later having spent the past hour on unrelated web sites, most people nod knowingly, and list their own particular online temptations. Some go on to detail the strategies they have engaged in an attempt to thwart that temptation, usually with the rueful admission that these attempts have been only partially successful at best.

Computer procrastination is an interesting problem, because it is a real-world, everyday problem which significantly reduces human flourishing in computer use. It is complex, poorly understood, and understudied. It calls out for insight, and is thus an ideal test case for the HUCF. While there is much anecdotal evidence that this type of procrastination is prevalent, there is surprisingly little academic research into the phenomenon. In addition to providing insight into the problem itself, a truly expansive computer use framework ought to be able to engage with existing bodies of research to understand why they are not addressing this widespread and important problem.

1.5 AIMS AND OBJECTIVES

1.5.1 *The Research Question*

The question which this PhD research seeks to answer is:

Is the Human Use of Computers Framework a helpful tool for understanding computer use, including complex everyday problems such as computer procrastination?

Note that the primary concern being expressed in this question is one that involves assessment of the framework. As was briefly discussed in Section 1.3.2, assessing the fruitfulness of a framework takes a dramatically different form than testing a theory. This will be explored in greater depth in Section 4.1. Also note the secondary role of the computer procrastination problem. As was discussed in Section 1.3.2, assessing the HUCF requires it to be applied to a difficult problem to see whether or not fruitful insight emerges. Having identified the problem of computer procrastination as a suitable primary problem for this assessment, this problem should be named in the central research question. However, it is also important to emphasize that the main issue of the thesis is the assessment of the framework, with any insight developed into the test problem forming only a secondary contribution. Therefore, the phrasing of the research question needs to allude to the procrastination problem, but in a way which keeps the assessment of the framework itself central.

1.5.2 *The Research Objectives*

In order to answer this question, a number of research objectives will need to be achieved. They are listed below, accompanied by a brief explanation for why these objectives are necessary.

1. Show how use of the Human Use of Computers Framework can provide insight into the problem.
    - In order to demonstrate how the framework helps us understand complex, everyday problems, it is necessary to show the framework in use. This means we must analyse one or more problems, view these situations in an integrated manner, and call attention to previously overlooked insights and connections.
    - Demonstrating fresh insight will require an understanding of both what is meant by "insight" and what is meant by "fresh". These are provided in Section 8.2.1. Insight into an unsolved problem involves viewing it in a new light, restructuring it, and then seeing the solution in the context of the concrete situation, rather than in terms of abstracted theory.
2. Show how other research approaches the problem and demonstrate that the available understanding is insufficient.
    - This objective is necessary, because I can only claim that the insight produced by the framework is important if it is fresh insight. If the results of the framework are simply a retread of results that are available elsewhere, the claim of fruitfulness is compromised. For example, by showing that the problem of procrastination is both complex and insufficiently understood, I demonstrate its worth as a test case for the framework.
3. Show how the framework can constructively engage other areas of research.
    - A framework for understanding an area is a way of seeing that area. It influences what we consider important, what problems are to be solved, and what approaches are legitimate for solving them. It does

not, in and of itself, assert or reject any particular theories or models. As a result, it is important to demonstrate that the framework does not argue *against* extant research, since it does not claim that existing theories and models aren't insightful. The role of a framework is to enhance other work by placing it in a coherent context with other research, not to replace it.

4. Critique and improve the framework.

    - Understanding is never complete. The framework, as a tool for insight, makes no claims to completeness or perfection. It is inevitable that when it is put to work in analysis of complex, everyday problems, shortcomings of the framework may present themselves. Part of answering the basic research question, then, is to understand and address these limitations of the framework, so that it is even more helpful than it originally was.

1.6 PLAN FOR THIS THESIS

After this introductory chapter, Chapter 2 investigates the notion of a Framework For Understanding (FFU), so that we can better grasp the role that a FFU can play, and then looks at existing approaches used to understand computer use. It will briefly investigate the ways that these existing approaches are insufficient for understanding computer use. Chapter 3 introduces the Human Use of Computers Framework (HUCF) in detail, and explores some of the relationships among the different parts of the framework. Chapter 4 describes the research methodology that is used to meet the objectives listed in Section 1.5.2.

Chapter 5 demonstrates the use of the framework on a variety of computer use situations. While not all of these situations are distinctly problematic, this is useful for demonstrating the breadth of types of use the framework can address, and provides multiple examples of what analysis using the framework entails.

Chapter 6 is somewhat unique, as it forms a “miniature thesis” on its own. The methodology adopted in this mini-thesis involves investigating an example computer use that is problematic, and verifying that the HUCF can provide insight into that problem. This will involve the same steps as a typical PhD thesis: Identifying the issue, reviewing existing approaches to understanding it, clarifying why they are unsatisfactory for doing so, implementing some new approach to understanding the issue, and discussing the findings that result. Therefore, the chapter on procrastination will be longer than the typical chapters, and internally organized much like a thesis that could stand on its own. Despite this, it will be important to remember that the goal of the research is not first and foremost to understand computer procrastination, but to understand and gain confidence in the HUCF. New insight into computer procrastination that results from this study can also be valuable, of course, and forms a secondary contribution for this thesis.

Chapter 7 collects and discusses a number of the observations that arise out of the results presented in Chapters 5 and 6. It does this in preparation for presenting the findings in Chapter 8, which makes the final case that the HUCF is, indeed, a fruitful and insightful framework for analysing computer use. The concluding chapter summarises the research, demonstrates that the objectives have been met, and discusses the reliability and limitations of the research. It concludes by summarising the contributions that this research can make to the larger community and to human flourishing in the world.

1.7 CONTRIBUTIONS

The research contribution can thus be seen from these two mutually beneficial perspectives: As the demonstration and testing of a novel framework, and as research into a practical problem (computers and procrastination). The former is the more fundamental contribution to research, but to demonstrate the practical efficacy of the framework, it is important that the research does not stray too far from the down-to-earth issue being analysed. Thus the insights into the problem of computers and procrastination also form a real and important contribution of this research.

The goal of using the framework is to promote human flourishing and shalom in all aspects of our computer use. By demonstrating that the HUCF can make a positive difference in both our understanding of and also our use of computer technology, this thesis will make a compelling case for other researchers and practitioners to avail themselves of the utility of this framework in their own work. This will be accomplished by demonstrating how the framework provides insight into complex computer use situations, that it can uncover hidden dimensions of use, it can help users to alter their own use to be more normative, and can help to integrate understanding and insight about computer use from multiple disparate fields of inquiry. Thus, the primary audience for this research consists of a large number of both researchers and computer professionals who could benefit from the clarity and insights that can emerge from the use of this framework. This includes HCI and **is!** (is!) researchers, software designers, and philosophers of technology.

1.8 NOTE ON WRITING STYLE

I recognise that the most common writing styles for PhD theses eschew the use of the first-person singular voice in writing.

This often results in use of the passive voice, or otherwise awkward writing structures. The reason for this tradition lies in the perceived need to present the work as objective and unbiased (Thompson Writing Program, 2008). In the post-modern era, it is increasingly recognised that any author always brings some sort of bias with them, and that truly objective writing is thus neither possible nor desirable. However, by removing from plain sight the role the author necessarily plays, unnecessary avoidance of the first-person voice can actually obfuscate the potential biases that are present, thus defeating the very purpose of avoiding such a writing voice in the first place. Therefore, in this thesis I will use a first-person singular writing style when appropriate, such as in the narrative sections of the text where my activity as an author and researcher is part of the topic being discussed, while using the more standard third-person writing style in those parts of the text where I judge my role as an author can play a lesser role in the proper understanding of the text.

2 THE PROBLEM WITH EXISTING FRAMEWORKS

2.1 INTRO

This thesis is primarily concerned with examining one particular framework for understanding, the framework for Human Use of Computers, which will be presented in Chapter 3. However, before that, it is important to take a look at what a framework is, and at some of the existing frameworks used by various research communities to understand human use of computer systems. This must be done in order to understand the context in which this research occurs.

This chapter is divided into two sections. First, Section 2.2 examines what, exactly, is meant by the phrase "Framework for Understanding", as used by Basden (2008). This is accomplished both by reviewing scholarly literature about frameworks, and by looking at examples of other uses of that phrase.

The second area of research reviewed is that of frameworks employed in thinking about computer use, presented in Section 2.3. Although the developers or practitioners of many of these approaches don't consciously consider them to be a framework for understanding in the sense used here, they do function that way, at least informally, in use. Reviewing these will demonstrate that these existing perspectives are valuable, but ultimately insufficient for seeing the "big picture" of computer use as it plays out in everyday life.

2.2 FRAMEWORKS FOR UNDERSTANDING

The notion of a "framework for understanding" which Basden (2008) adopts in his book *Philosophical Frameworks for Understanding Information Systems* is original and idiosyncratic:

> A Framework For Understanding (FFU) an area is a way of seeing the area. But that involves many things, including the actual (social) activity of practice and research within the area, the implicit understanding that functions within this, making some understanding explicit, interpreting it conceptually, discussing the appropriateness of conceptual frameworks, and proposing better conceptual frameworks.
>
> An FFU guides both research and practice in the area and itself emerges out of and may be refined by such research and practice over the years. Some have arisen from practice, others from research. Some frameworks for understanding an area are explicitly stated while others might be tacit. (Basden, 2008, p. 11)

> The framework for understanding an area adopted by us influences or determines the conceptual apparatus we employ when working in the area – how we classify things, what theories we devise and kinds of methodologies and rules we formulate to guide our research or practice, what we see as important in the area, what types of questions we find ourselves asking, what we see as problematic and what we allow as possible solutions.(Basden, 2008, p. 13)

It is essential to note from this that a framework is *not* the same as a theory. A theory is a claim about the some phenomenon, event, or entity. A theory can be judged based on its validity, or more simply, whether or not it is true. A framework is not a claim about reality, but rather, a pre-theoretical lens through which reality is viewed. That is, it is a claim about what is meaningful. This is an important distinction, because, as will be applied in Section 4.1, a framework must be assessed in a very different way from a theory. The test for a framework is not whether it is true or valid, but whether it is fruitful and insightful.

This use of the word *framework* is echoed in in the work of Mitcham (1994, pp. 154-156), who also uses the word to describe an apparatus that enables us to theorize, categorize, and contextualize. This section will demonstrate that this usage is commensurate with similar usage of the language in other fields, and in doing so, help to deepen understanding of what a framework is, and how it is used.

2.2.1 *Kuhn's Concept of Paradigm*

A framework for understanding is similar in concept to the notion of *paradigm* introduced by Thomas Kuhn (1996). Kuhn's concept of *paradigm* includes the framework-like notions of what constitutes a legitimate problem for research and an implicit conception of what can be considered a solution to such a problem. "Paradigm", as defined by Kuhn, requires a way of looking at an area that is "sufficiently unprecedented to attract an enduring group of adherents away from competing modes of scientific activity, [while remaining] sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to resolve" (Kuhn, 1996, p. 10). However, his emphasis is on the role that paradigms play in revolutions within the sociology and history of science. Thus his concept pulls us in a direction that is less useful in exploring what a framework for understanding is as it relates to human use of computers.

In a postscript to the third edition, Kuhn suggests the use of the phrase "disciplinary matrix" (Kuhn, 1996, p. 182) to describe the use of a *paradigm* which is commonly possessed by a field of practitioners and provides a structure in which theorizing and research can occur. This is somewhat closer to the way in which *framework* is used in this thesis. A paradigm can be identified according to what is meaningful to the practitioner or researcher and is often held subconsciously, and thus implicitly. A framework attempts to make that explicit, when held consciously (Joneidy & Basden, 2013).

A second reason why Kuhn's notion of *paradigm* is not identical to this concept of *framework* is his emphasis on a paradigm as a shared set of commitments which help us to understand and define the community of scientific research which holds that paradigm. While conceptual frameworks are generally communally held in practice, in theory there is no reason why a framework for understanding could not be held by a single individual. Because the emphasis in discussing frameworks for understanding is not on understanding the community that forms around the framework, but rather on the ability of the framework to provide coherent and fruitful insight into the area, the use of *paradigm* is less appropriate here.

Difficulty in pinning down exactly what is meant by Kuhn's *paradigm* is not new. Masterman (1970, p. 61) has counted not less than 21 different senses in which the word is used by Kuhn. She divides these into three broad categories of meaning: metaphysical paradigms, sociological paradigms, and artefact paradigms (Masterman, 1970, p. 65). As used here, the notion of a framework has significant overlap with the metaphysical paradigm and the artefact paradigm, but almost none with the sociological paradigm. Masterman's (1970) emphasis on defining a paradigm in terms of "what a paradigm does" (p. 70), works well with this notion of framework.

2.2.2 *Other Frameworks For Understanding*

While a number of other researchers from across a wide variety of disciplines use the language of a "framework for understanding", it is actually very rare that they discuss what they mean by this phrase in any detail. As a result, some subjective interpretation is often required to determine how the concept is being used.

Understanding information systems research methodologies

In a significant survey paper, Iivari, Hirschheim, & Klein (2001) used the notion of a framework to organise, classify, and understand the multiplicity of methodologies proposed and used in information systems development, to "construct an organising structure that reduces the complexity of the myriad of [information systems design methodologies]" (p. 180). Although they do not use the exact phrase "framework for understanding", they do emphasise several features of their framework which resonate with Basden's usage: It is intended to be useful to practitioners in addition to theory-based researchers, and it is designed to bring hidden assumptions to the fore, exposing possibilities which may have been overlooked due to narrowness of vision. While Iivari's framework is theoretically-based rather than lifeworld-oriented like Basden's, it demonstrates a sensitivity to many of the same basic issues which Basden's frameworks are designed to address.

Classifying various e-business models

Pateli & Giaglis (2003) also use the notion of a "framework for understanding" as a tool for classifying existing research approaches, and to guide future research in an area. In this way, they are also seeing a framework as a lens through which to view an existing field in a way that organises that field into a coherent whole.

Business process modelling

Melão & Pidd (2000), analyse various perspectives on business process modelling, and use the concept of a "framework for understanding" to refer to a structure which "provides a useful way of organizing different points of views about business processes and allows a discussion of the assumptions underlying [business process modelling's] main streams. Thus, a richer and wider picture is likely to occur" (Melão & Pidd, 2000, p. 112). This emphasis on integrating and accounting for the insights of existing streams of research is echoed in Basden (2008) when he discusses "how to account for both the incommensurabilities between extant frameworks and the links between areas, and to find a way of converting incommensurability into mutual respect" (p. 15).

Understanding the effects of invasive species

In an example of usage of this phrase from the life sciences, Parker et al. (1999) created a "framework for understanding the ecological effects of [non-native] invaders" which they describe as "a synthetic approach to defining, evaluating, and comparing the impacts of nonindigenous species" (p. 4). The notion of a framework as "defining, evaluating, and comparing" the phenomenon under consideration squares well with Basden's notion of a framework described above.

Developmental psychology

Stanton-Salazar (1997) uses the phrase "framework for understanding" to describe his model for understanding early childhood socialization. He appears to use the phrase synonymously with "conceptual framework". His framework is introduced in the context of critiquing current approaches to the issue, using the language of "prevailing view" (p. 2), "[research] tradition" (p. 2), "conventional emphasis" (p. 3), and "perspective"

(p. 3). His framework, in turn, provides "conceptual tools" (p. 3), "exposes fundamental ... processes" (p. 3), and "unmasks a plethora of mechanisms in contemporary institutional life" (p. 3). Thus, this usage is commensurate with Basden's emphasis on the normative role a framework plays in determining "what we see as important in the area, what types of questions we find ourselves asking, what we see as problematic and what we allow as possible solutions" (Basden, 2008, p. 13).

2.2.3 *Basden's Concept of a* Framework for Understanding

However, all of these examples of frameworks for understanding from other fields are primarily *theoretical* frameworks. While keen to appreciate the significant insight which such theoretical approaches can provide, Basden cautions against relying upon a theoretical attitude: "[S]uch ways of understanding ... focus on a narrow range of issues. ... The danger is that that very focus can lead researchers and practitioners to assume that nothing else is meaningful, and so other issues become downplayed, suppressed, and ignored." (Basden, 2008, p. 8) Instead, Basden turns to philosophy, and a "lifeworld" orientation rather than a theoretical one. In this sense, the while theory abstracts, the role of philosophy is to integrate, to understand the coherence between the various fields of inquiry (Strauss, 2009).

While the above uses of "framework for understanding" do not use the phrasing of "lifeworld orientation", many of them seem to display an intuitive sensitivity to the need for a framework to account for "the big picture" rather than focusing on a narrow, theoretically-driven perspective. Thus we can see that while Basden is more explicit and intentional about his use of the phrase "framework for understanding", his usage is commensurate with other researcher's approaches.

2.3 FRAMEWORKS FOR UNDERSTANDING COMPUTER USE

A framework for understanding the human use of computers is implicitly operating any time one adopts a theoretical attitude while considering computer use in any level of abstraction. Thus while researchers seldom use the exact phrase to describe their approach, and indeed, often fail to describe their approach explicitly at all, such a framework is in play nonetheless.

Human-Computer Interaction, and the related engineering field of Human-Machine Interface Design, investigate how humans interact with technological systems, but often does so with a narrow cognitive focus, and without a well-defined conceptual basis (Lintern, 2000).

Part of demonstrating the utility of a new framework for understanding the human use of computers, then, will be to place the use of such a framework in the context of alternative ways of understanding computer use.

Some examples of such frameworks are explicitly and formally discussed, while others are implicitly held, requiring some analysis and interpretation to discern.

Psychological behaviour

Some of the first formalized thinking about human computer use emerged in the 1970's, when researchers attempted to match the interaction with the machine to the abilities of the human operator. "Part of the programme of cognitive science was to articulate systematic and scientifically-informed applications to be known as 'cognitive engineering'. [...] The way forward for computing entailed understanding and better empowering users" (Carroll, 2010, p. 3). As an example of this approach from within the field of Human-Computer Interaction (HCI), Bessière et al. (2006) studied the role of frustration while using information systems, with an aim towards formalizing the way practitioner view and use the term frustration. A well known, more formal theoretical structure is the Cognitive Dimensions Framework (Blackwell & Green, 2003), which provides a structure for thinking through the design of a computer application, with a particular emphasis on the interface. "The Cognitive Dimensions framework is not an analytic method. Rather, it is a set of discussion tools for use by designers and people evaluating designs"7 (Blackwell & Green, 2003, p. 106).

As the field exploring the psychological behaviour of computer users developed, it was gradually absorbed into the area of Human-Computer Interaction. This is unfortunate, because it limits the ability of psychology to speak to the meaning of computers in our everyday lives, rather than just our cognitive functioning with the interface (Basden, 2008, p. 159).

Human-Computer Interaction

Research in Human-Computer Interaction (HCI) is interdisciplinary and multifaceted, embracing ergonomics, sensorimotor channels, interface objects, user-computer dialogue structure, proximal interfaces, cognitive dimensions, and much more (Carroll, 2014; Dix et al., 2004). Much of the research builds on foundations laid in general and cognitive psychology.

Of particular note is the notion of *affordances,* which are the inherent properties of technological artefacts which allow and constrain the uses to which those artefacts may be put (Greeno, 1994; Hutchby, 2001; Norman, 1999). In this way, affordances characterise the possibilities that objects offer for action. In HCI research, this notion plays an important role, because the way in which the user *perceives* the possibilities for action using the interface limit the usefulness of the application for the user.

However, while the HCI field provides a robust structure for reasoning about the user's interaction with the interface, it does not consider the way in which the information system is meaningful in the everyday life of the user. For this reason, it is a necessary, but not sufficient field of research for understanding human use of computers.

A matter of cost versus benefits

In researching information systems in the context of the business world, the most common framework for seeing the use of computers is through the ECONOMIC lens of cost versus benefit. When deciding whether or not to implement a proposed information system, the typical practice is to calculate both what the implementation would cost in terms of development, training, infrastructure, etc., and what the predicted benefits would be in terms of employee productivity, customer satisfaction, competitive advantage, etc. Neither the cost, nor the benefits are simple to estimate, and significant research has been performed to assist in making these predictions increasingly accurate.

While it would obviously be irresponsible for a business organization to make major information technology decisions without performing such a cost/benefit analysis, this makes a poor dominant paradigm for understanding human use of computers, because it only considers one aspect of human living, ignoring other important areas.

Technology Acceptance Model

One stream of research that falls into the category of better predicting costs and benefits is the Technology Acceptance Model (TAM). This is a body of research that provides a model for predicting whether an information system (or a part thereof) will be accepted and used by the members of an organization. First introduced by Fred Davis (1989) in a landmark paper, the model has been updated and amended, by Davis and others, to cover a wide variety of areas, such as internet use (Teo, Lim, & Lai, 1999), game playing (Hsu & Lu, 2004), or mandatory use (Brown, Massey, Montoya-Weiss, & Burkman, 2002). It is a tremendously influential model (Lee, Kozar, & Larsen, 2003; Bagozzi, 2007; Venkatesh & Bala, 2008), with good predictive power regarding the acceptance or rejection of new information systems.

Based on thinking that comes from the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975) and its successor, the Theory of Blanned Behaviour (TPB) (Ajzen, 1991), TAM's main premise is that a user's attitude towards a computer application is the primary determinant of their intention to use it, and thus their actual use of it. Davis further posited that the user's attitude towards technology use can best be captured by the constructs of *Perceived Ease Of Use (PEOU)* and *Perceived Usefulness (PU)* (Benbasat & Barki, 2007). Each of these two variables is measured by a variety of scaled item questions in the data-collection instrument. *Usefulness*, as defined by Davis, is "the degree to which a person believes that using a particular system would his or her job performance" while *ease of use* is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320).

While TAM has proven efficacy at predicting use, it is not able to effectively reason about *why* a given program is perceived to be easy to use or useful. One researcher notes that "PU and PEOU have largely been treated as black boxes that very few have tried to pry open" (Benbasat & Barki, 2007, p. 212). This is perhaps because the constructs available in TAM are not able to consider the content of a program, but only its interface (ease of use) and utility in the workplace (usefulness). A framework that considers the interface, the content, and the real-world impact will be able to provide a much fuller picture of computer use.

Power, conflict, and emancipation

In reaction to the organisation-centric view of much of the information systems field, some researchers have adopted a critical thinking stance in information systems. Related to Marxist thought, this stream of research proposes to address the imbalance in power that exists in many organizations (Myers & Klein, 2011). While this stance is often a necessary corrective to existing injustice, by focusing exclusively on issues of power and control, such frameworks overlook other large areas of human activity, such as friendship, enjoyment, loyalty, and self-giving.

Soft-Systems Methodology

Soft-Systems methodology is an influential method for considering complex systems, most popularized by Checkland (1999). It has a long history of influence in the field of information systems analysis and design. It is an attempt to address real-world problems using a cyclical learning process, attempting to avoid the reductionism of natural science. When applied to information systems specifically, it treats information systems as "being centrally concerned with the human act of creating meaning" (Checkland, 2000, p. S12). This way of approaching complex human systems is influential in the field of information systems, and has much to offer. Its focus or the meaningfulness experienced by the human subjects is highly compatible with the Dooyeweerdian foundation of the HUCF. However, as Bergvall-Kåreborn (2002) points out, the ability of the methodology to promote genuine change rather than supporting the status quo and propping up the already-powerful has seen limited success.

Structuration theory

Developed most prominently by Giddens (1984), Structuration Theory is another influential model for understanding human social systems, and has been used repeatedly in the IS field (Jones & Karsten, 2008). It rests on the notion that the structures of society and the agency of human individuals create each other in a "mutually constitutive duality" (Jones & Karsten, 2008, p. 131). However, Giddens work makes only sparse mention of technology, and finds that technology can only assert any effect on the structures of society through the actions of mediating human agents. Because, under Structuration theory, "[social] structure ... cannot be inscribed or embedded in technology" (Jones & Karsten, 2008, p. 132), it is not an ideal framework for understanding the nature of computer use by humans.

Actor-Network Theory

Actor-Network Theory, developed in part by Latour (1999), has gained the interest of information systems researchers because of its ability to seamlessly integrate human actors with non-human entities in the complete socio-technical system (Walsham, 1997). Because it intentionally makes no distinction between human and non-human actors, it is not well-suited for a framework oriented towards the everyday experience of computer use, because users experience that distinction as meaningful and important.

Information Systems Success Model

DeLone & McLean (1992) wrote a highly influential paper defining what is meant by "success" in studying the implementation of information systems, attempting to integrate various extant approaches. Their model is a rich one, including the concepts of: System quality, information quality, information use, individual impact, and organisational impact. In 2003, they updated their model (Delone & McLean, 2003), with relatively minor modifications to the structures, including separating intention to use from use itself, and combining individual and organisational impact into a single "net benefits". However, the design and constructs for these models, and the extensive lists of measures which support these constructs (DeLone & McLean, 1992, pp. 83-84) make it clear that the research "shows the interests of researchers, ICT suppliers and senior management rather than that of those who use the system" (Ahmad, 2012, p. 168). Only the crude construct of "user satisfaction" attempts to understand the meaningfulness the user experiences in the everyday use of the system.

2.4 SUMMARY

In Section 2.2, we saw that the kind philosophical framework which Basden (2008) presents is commensurate with similar frameworks in other areas of information system research and from other disciplines. Section 2.3 briefly surveyed other ways of viewing computer use that have framework-like characteristics, and showed that they are either too informal or too narrow to be holistically insightful about the broad spectrum of meaning involved in human use of computers. The next chapter will introduce Basden's framework for understanding and analysing computer use, and explore what it means to say that this framework needs to be assessed.

3

THE NEW APPROACH

3.1 Introduction to the Human Use of Computers Framework

As seen in Section 1.3, human use of computers is a highly multifaceted phenomenon, with activity and impacts occurring in many areas of life. In order to consider this diversity systematically and to find a coherence within it, Andrew Basden has developed a philosophical framework for understanding human use of computers, called the Human Use of Computers Framework (HUCF). Developed in Chapter 4 of Basden's 2008 book, *Philosophical Frameworks for Understanding Information Systems*, the HUCF draws heavily upon the philosophy of 20th century Dutch philosopher Herman Dooyeweerd.

The purpose of this chapter is to summarize Basden's HUCF sufficiently for the reader to understand the use and analysis of the framework that is demonstrated in later chapters. In addition, some preliminary critiques of and improvements to Basden's original framework will be presented, and deeper insight into how the parts of the framework relate will be developed.

3.1.1 *Philosophical Orientation*

Philosophy seeks to find and explain the coherence between various fields of understanding (Strauss, 2009), and is thus ideally suited for examining the complexities of computer use, because it gives a wide, cross-disciplinary view. It can be a very practical tool that enables disparate research areas to be seen as part of a broader picture. Thus, frameworks built on a philosophically sensitive foundation can point to previously understudied areas and prompt us to ask important, new questions.

Basden's HUCF was developed using the multi-aspectual philosophy of the 20th century Dutch philosopher Herman Dooyeweerd (1955–1958). Dooyeweerd's thought is deeply non-reductionist: He makes the strong claim that reality is meaningful in a wide variety of mutually irreducible *aspects*. For example, he specifies that the biotic world can not be reduced to only physical, nor can aesthetics be reduced to the social. Dooyeweerd identified a suite of fifteen *modal aspects*, and posited that each of these aspects operates under a different set of laws which enable meaningful functioning in that aspect. (These aspects are listed and briefly described in Section 3.3.) The suite of aspects suggested by Dooyeweerd has been utilized in the development of the HUCF, but more important than the actual suite of aspects is the emphasis on the *multi-aspectual nature of reality*. This means that meaningfulness in a given aspect cannot be reduced to any other aspect. The Dooyeweerdian emphasis on irreducibility amongst aspects holds regardless of exactly which categories of meaning (aspects) any given thinker identifies.

Thus, the framework is a *philosophical* framework in the sense that it requires the user to consider the practical implications of questions from areas of philosophy such as ontology, epistemology, ethics, methodology, anthropology, and critique of presuppositions (Basden, 2008, pp. 16-17).

3.1.2 *Everyday Nature of the Framework*

The HUCF is an explicitly *everyday* framework. That is, it deals with matters that arise in day-to-day use of computers, without requiring that they be theorized or formalized. This *pre-theoretical* stance lends dignity to the experience of using the computer as it is actually perceived. This use of "pre-theoretical" is similar to the notion of the "life-world" in Husserl (1970), retranslated by one scholar as "common-sense experience" (Smith, 1995, p. 394). Dooyeweerd uses the phrase "naïve experience" and "pre-theoretical attitude" (1955–1958, Vol 3, p. 3), while other Dooyeweerdian scholars adopt terminology such as "ordinary experience" (Clouser, 2005, p. 254), "everyday experience" (Basden, 2008), or "down-to-earth issues" (Ahmad, 2012).

3.1.3 *Structure of the Framework*

It can be helpful to visualize the Human Use of Computers Framework (HUCF) as a two-dimensional array, with two sets of orthogonal distinctions to be made; this is shown in Figure 1. The first distinction that the HUCF makes, horizontally, is to differentiate the diverse *kinds of human functioning* which a user takes on, simultaneously, when using a computer. The second distinction, shown as vertical, is to analyse the various *modal aspects* (in the Dooyeweerdian sense) in which each type of engagement occurs.

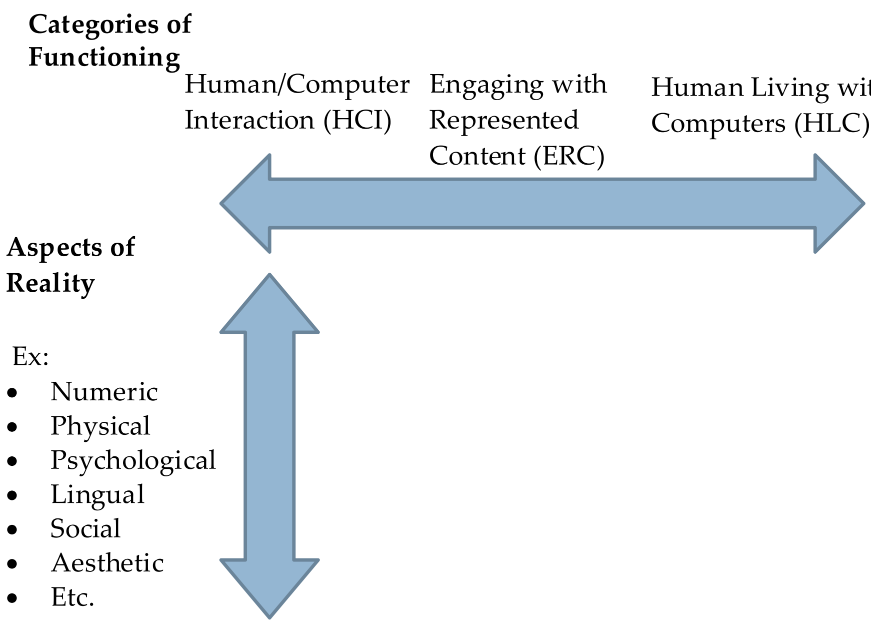

Figure 1: The HUCF as two-dimensional array

3.2 DISTINCT HUMAN FUNCTIONINGS

Each distinct category of human behaviour corresponds with a different entity of engagement, of which Basden identified at least three:

- The computer itself (Human-Computer Interaction)
- The content of the software being executed (Engaging with Represented Content)
- The everyday life of of the user (Human Living with Computers)

These functionings can be seen as different *levels* of interaction, from the lowest level of interacting with the hardware and the interface, up to the highest level of engaging with the full life of the user. The content level stands between these two, and in some sense, mediates between them. This will be explored more in Section 3.6. It is also possible to envision additional levels, such as the level of the larger environment within which the computer use takes place.

3.2.1 *Human-Computer Interaction*

When a person uses a computer, the most basic form of interaction they have is with the machine itself, so this functioning is called Human-Computer Interaction (HCI). This includes:

- The physical interface hardware, such as:
  - punch card input and printer output of early terminals
  - keyboard, mouse, and video screen of the traditional personal computer
  - touch-screen interface typical of mobile phones and tablets
  - custom control panels for embedded devices

- The associated interface software, such as:
  - command-line interfaces
  - the WIMP GUI (Windows, Icons, Menus and Pointers Graphical User Interface) typical of modern desktop operating systems
  - Gesture-based control used with touch-screen devices
- Other particulars of the user experience of the interface, such as:
  - The immersive qualities of virtual reality and computer games
  - The "set-it-and-forget-it" nature of embedded control systems (such as a programmable thermostat)
  - Interface-based dysfunctions or pathologies, such as repetitive strain injuries (RSI)
  - Multiple windows with separate tasks being completed simultaneously, in modern desktop operating systems
  - And many others

As a widely studied academic discipline in its own right, Human-Computer Interaction is the best-understood of the three functionings.

3.2.2 *Engaging with Represented Content*

The second category of functioning involves the user's interaction with whatever the program is *about*. The existence of this category relies upon the observation that our reason for using the computer is almost never about the interface itself. For example, people do not generally read a web page for the pleasure of scrolling with the mouse or arrow keys. Users do not play games because they enjoy the soft, warm light of the video monitor flickering on their face. They do not open a spreadsheet because they enjoy the pleasant colour patterns of the windows and icons. In each of these cases, the features of the interface matter, but are not the primary driver of the interaction.

Instead, the more crucial human functioning is the engagement that takes place with the *content* of the application – the information on the web page, the virtual world within the game, and the calculations on data in the spreadsheet. It is the engagement with this content, represented in the computer, that forms the second human functioning.

The original HUCF, as formulated by Basden, uses the phrase "Engaging with Represented Content" for this category of functioning. However, for reasons that will be explored in Section 3.4, the concept of *represented* content turns out to be both surprisingly problematic and unnecessary. One of the improvements this thesis provides to the framework is the identification and remediation of this problem.

3.2.3 *Human Living with Computers*

The third category of human functioning is about the interaction of the user with their own life and the effects of the computer on the user's everyday living. This category asks questions about *why* the user is using the computer in the first place, and what role the content (from the Engaging with Represented Content (ERC) category) plays in their life, whether beneficial or detrimental. Thus, this category is called "Human Living with Computers". Although the phrase "real world" is problematic, talking about "how computer use affects things in the real world" does provide an intuitive glimpse of what this category of functioning addresses. This functioning thus takes another step back from the computer itself, and looks at the larger context of the human life within which the computer is used.

The use of these three categories of human functioning are best understood by example, so a number of computer use situations will be analysed using this framework in Chapter 5.

3.3 MULTI-ASPECTUAL HUMAN FUNCTIONING

One main attraction of Dooyeweerd's thought is that it is deeply non-reductionist, with the observation that reality is meaningful in a wide variety of aspects. He delimited these aspects as follows:

QUANTITATIVE of discrete amount

SPATIAL of continuous extension

KINEMATIC of flowing movement

PHYSICAL of energy and mass

BIOTIC/ORGANIC of life functions and integrity of organism

PSYCHIC/SENSITIVE of sense, feeling, and emotion

ANALYTICAL of distinction, conceptualizing, and inferring

FORMATIVE of formative power and shaping, in history, culture, creativity, achievement, and technology [1]

LINGUAL of symbolic signification

SOCIAL of respect, social interaction, relationships, and institutions

ECONOMIC of frugality, skilled use of limited resources

AESTHETIC of beauty, harmony, surprise, and fun

JURIDICAL of what is due, rights, responsibilities

ETHICAL of self-giving love, generosity, care

PISTIC of faith, commitment, trust, and vision

These aspects are irreducible to each other. For example, issues of technology are not reduced to psychology, nor is enjoyment reduced to functional purpose. To Dooyeweerd, the aspects are not just categories, but are modes of functioning and existing, ways in which reality can be *meaningful*. Each aspect provides

1 The FORMATIVE aspect is sometimes also referred to as the HISTORICAL aspect or the CULTURAL aspect.

a distinct set of laws that enable functioning in that aspect and different kinds of repercussion to occur. Human life and activity are thus seen as a functioning in all aspects simultaneously.

Each set of laws implies a different kind of normativity. For example, the ANALYTICAL normativity of being rational, LINGUAL normativity of clarity, ECONOMIC normativity of avoiding waste and PISTIC normativity of faithfulness. The laws of the earlier aspects are largely descriptive; that is, we cannot disobey these laws. The later laws, on the other hand, are prescriptive, and thus normative. They tell us how we *ought* to function, but do not force us to do so. For example, in the ECONOMIC aspect, the law/norm of frugality tells us that we ought to use our time wisely. It allows us to make predictions about what kinds of consequences we can expect from obeying or not obeying that norm, but the choice of whether or not to follow the norm is ours to make.

Monsma et al. (1986) have made suggestions regarding how each of the later aspectual norms is best characterised when considering technological artefacts used in the context of an organisation (pp. 170-177). These are summarised below.

FORMATIVE *Cultural appropriateness* – technology should promote, not destroy, the desirable qualities of the community or organization. Those who work with technology should be an integral part of the community or organization.

LINGUAL *Information/openness* – the expectations of the organization should be clear to all.

SOCIAL *Communication* – Technology must promote social interaction and community, not hinder them.

ECONOMIC *Stewardship* – The organization must consider the economic, material, technological, and temporal aspects of stewardship. The organization must be able to provide and fund the technology, instruction, and organization necessary for the technology without compromising its goals.

AESTHETIC *Delightful harmony* – Technology should help the organization in meeting its goals and objectives, and be satisfying to its users. The mission of the organization must drive the implementation of technology; the limitations of the technology should not impact the goals of a course or the mission of the organization.

JURIDICAL *Justice* – The technology should help the organization give what is due to whom it is due. The users and those who design, implement, and maintain the technology must be valued appropriately.

ETHICAL *Caring* – The organization should implement technology so that it can treat its members in a loving manner and serve them in a loving way.

PISTIC *Trustworthiness* – The implementation of the technology used should be as reliable as possible.

The non-reductionist approach of Dooyeweerd's philosophy allows the framework to take everyday life seriously. That is, in our everyday experience of reality, we do not intuitively experience everything as mathematical, physical, or logical, but rather as diversely meaningful. This leads us to expect that a framework rooted in Dooyeweerd's philosophy should be able to address a wide variety of factors that are meaningful in computer use, and to provide various ways of understanding benefit and detriment. That Dooyeweerd began his philosophy with what he called the *pre-theoretical attitude of thought*, together with the diversity of meaningfulness that his aspects recognise, suggests an ability to understand everyday life, not just professional or academic contexts.

The Shalom Principle

Basden also refers to the *Shalom Principle*, the notion that "if we function well in every aspect then things will go well, but if we function poorly in any aspect, then our success will be jeopardised" (Basden, 2008, p. 105). Goudzwaard (1979) referred to this concept as "Simultaneous Realization of Norms". The notion of *shalom* will be used in Section 3.7 in discussing how the categories of functioning relate to each other.

3.4 ADDRESSING THE DIFFICULTY WITH ERC

In most cases of computer use, the hardware and the interface are not the primary route to meaningfulness in the user's life. As stated in Section 3.2.2, we don't usually use a computer in order to experience the pleasure of feeling the mouse under our palm, or to appreciate a well-structured data-entry screen, or to enjoy watching the graphical menus extend and retract. Each of these may be a bonus, but in order to have meaning in our lives, the program must not be just an interface, but must be *about* something.

This *something* is the content of the program, and it is the bridge that allows the computer to have meaning and use in our everyday life. In Basden's (2008) original framework, this is the Engaging with Represented Content (ERC) category, and it stands between the HCI functioning (the computer hardware and software interface) and HLC functioning, where the meaning of the computer takes up residence in our everyday lives. By calling our attention to this bridge and the crucial role it plays in understanding the meaning of the computer in our lives, Basden's framework adds great richness to any analysis of a computer use situation.

Problems with the Original ERC category

Unfortunately, while the value and importance of the ERC category are evident, in use it is often very difficult to pin down what exactly is being referred to. A more careful analysis of this category of functioning is helpful in narrowing down where this problem lies, and in addressing it.

First, note that this is a category of *human* functioning; this is emphasized by the use of the word *engaging*. What the HUCF seeks to analyse is not the computer or application as it stands on its own, but the human activity of using the system. In all but the most trivial of computer use cases, this involves some sort of interaction between the user and the content of the program.

Second, Basden (2008) refers to *represented* content: "functions, properties, beings, and so forth, that are represented in the computer, in its data structures and its algorithms that make calculations or undertake activities" (p. 130). There is a compelling simplicity to this notion of *represented*, as the criteria for inclusion seems straightforward – only that content which is explicitly or implicitly referred to in the software program itself qualifies. However, as we'll see, this restriction causes difficulties in use.

Finally, there is the word *content* itself. Dictionaries define content as "something that is to be expressed through some medium, as speech, writing, or any of various arts" (Content, 2012) or a more media-specific definition, "information and experiences that may provide value for an end-user/audience in specific contexts" (Content (media), 2014).

In the context of the HUCF, this engaging with content can occur in each of the 15 Dooyeweerdian modal aspects. In Basden's original formulation, there is an uncomfortable tension between whether the aspectual emphasis is on the human engagement or on the content itself. For example, does the LINGUAL aspect refer to the symbolic and communicative activity of the user as they engage with the program, or only the symbolic or communicative properties of the content itself? In discussing the definition, Basden tends towards the former, emphasizing the role of the human engagement with the content. But, in the provided examples, such as the analysis of the quantity surveying software ELSIE (Basden, 2008, p. 131), the emphasis seems to be on the aspectual meaning of the represented content only.

All of the entries in the ERC column could easily be stored in internal variables or algorithms in the software code.

Examples of the Problem

Consider, as an example, the use of Central Processing Unit (CPU) temperature monitoring software. Much of the engineering challenge in modern CPU design is dealing with the waste heat that is generated by transistor switching. Keeping the temperature of the CPU cores in a reasonable range is an important part of maximizing the longevity of a computer system. This is complicated by the competing priority of reducing noise from the cooling fan. In an attempt to run my fan at the lowest speed possible while still maintaining sufficient cooling, I have installed software which uses a temperature sensor built into the CPU and reports it to me as an icon in the corner of the screen. In this way, I can monitor the effects of various workloads and cooling fan settings, and take corrective action if the temperature of the CPU rises too high.

The *represented content* of such a program is primarily about the temperature of the CPU – a PHYSICAL phenomenon, expressed QUANTITATIVELY. However, when I use the software, I am also functioning ANALYTICALLY. Suppose that the software reports the CPU temperature is 65° C; I need to decide "Is that temperature too high? Do I need to intervene to cool things down?" Aspectually, this is an ANALYTICALLY qualified question. The question of how high is too high is absolutely related to the content, but is not itself *represented* anywhere in the content. That is, there is no internal variable or algorithm which deals with the question of how high is too high[2]. This observation prompts the question: When the user functions ANALYTICALLY with the temperature while using this software, is that part of

2 There are other temperature monitoring programs which do allow the user to configure an alarm to sound when a certain temperature is exceeded. In that case, the ANALYTICAL question of "How high is too high?" is indeed *represented* content.

their engaging with the represented content (ERC), or is it a matter of living their everyday life (HLC)? Intuition suggests that it is so directly involved with the content that it must be ERC, but this fails to meet the *representation* requirements for that category.

As a second example, consider the grade report email case which will discussed in detail in Section 5.1. In this scenario, a professor uses an the mail-merge feature of Microsoft Word and Excel to automatically email each student a custom grade report. Consider the JURIDICAL aspect, which is about notions of justice, fairness, and what is due. One of the requirements of a solid grading system is *fairness.* Is the fairness of the grading system part of the represented content in this case, or part of the human living with the computer? While there is no variable or data in the grading spreadsheet that specifically refers to fairness, it still seems as though this is a content issue rather than an everyday-life issue. Of course, there is nothing that prevents the question of fairness in grading to be part of both ERC and HLC, but that still does not negate the requirement that to be able to distinguish clearly which parts of human functioning are in which category.

Proposed Solution – Engaging with Meaningful *Content*

It is clear from these examples that there is something about the content of a software program that makes interacting with it distinct from either the HCI or from the everyday effects of computer use in living. However, we continually run into problems when reasoning about the nature of *represented* content. A very logical question then, is to consider the importance of the *represented* requirement. If the focus of the ERC category were on only the content itself, having this limiting criteria for inclusion would make some sense, as non-represented content may too slippery and ephemeral to analyse. However, the main focus of this functioning is not the content, but rather the human engaging with it. While the distinction between represented content and imagined content may be important, particularly during the development phase of software, in most instances the human user engages with them both.

Recall the CPU temperature monitoring example. In this particular case, the ANALYTICAL functioning, in terms of distinguishing safe from unsafe temperatures, dealt primarily with non-represented content. The cut-off temperature at which action should be taken was not, in this case, a value internally represented in the software, either on-screen, in-memory, or algorithmically; but the user was interacting with that value nonetheless.

Rather than engaging only with represented content, the user engages with any content, represented or not, that is *meaningful* in their life. By making this distinction, we can identify the bridge between engaging with the content and the HLC functioning, how the *meaning* of the content enters into their life. Thus, this thesis proposes renaming the ERC functioning from *Engaging with Represented Content* to EMC – *Engaging with Meaningful Content*, and will use the new phrase throughout the remainder of this document.

3.5 RECOGNISING HCI, EMC AND HLC IN OTHER RESEARCH

Because Dooyeweerd's suite of aspects is well known among the community of Dooyeweerd scholars, there are a number of excellent summaries of it, including Dooyeweerd's (1955–1958) magnum opus itself*, A New Critique of Theoretical Thought*, Kalsbeek's (1975) popular summary, Clouser's (2005) extension and application, and Basden's (2013) extensive and regularly updated web reference on aspects. However, the three human functionings are new to the HUCF, and so require more analysis.

Basden defined HCI, EMC, and Human Living with Computers (HLC) somewhat intuitively (Basden, 2008, p. 130). Therefore, in this section I'll explore a number of ways to envision the distinctions being made, and point out ways in which the existing research communities are already making some of these distinctions, at least informally.

3.5.1 *By Entity of Interaction*

The first way to differentiate between the functionings is to examine which type of thing is being interacted with.

- HCI functioning is interaction with the physical computer and the interface software. Thus, if something can be touched or makes a sensory impression on your retinas, for example, it is likely that you are interacting with it by HCI functioning.
- When you are interacting with something that is, in some sense, "in the computer", but is not something physical, it's likely that you're engaging with the content (Engaging with Meaningful Content (EMC)). For example, in a spreadsheet of temperature records, the value 273.16 K is, in some sense, stored internally in the computer's memory or on its hard drive, but is not itself physically present. (The *bit pattern* that represents this value *is* physically present, as voltages or capacitance in a silicon chip, as magnetically polarized iron oxide particles and a ceramic platter, or in other storage/processing mediums.)
- When the thing you are interacting with is not "in the box that is the computer" at all, it is likely that (everyday) human life itself is the entity of engagement (HLC). This is the category in which asking *why* the computer is being used at all can be answered.

This does not mean, however, that there are no grey areas in which there can be difficulty in differentiating the categories of functioning from one another. For example, when a user clicks on the "bold" button in a word processor to put the selected text in bold, that is clearly HCI functioning. However, when the selected words on the screen are then made bold in response to that, there can be some confusion about what, exactly, is being interacted with: Is the now-bold appearance part of the interface (that is, HCI functioning), indicating that those letters, when printed, will be in bold? Or is it the content of the application (that is, EMC functioning), that those words in the document that need to be emphasised now are? Indeed, it is the nature of WYSIWYG (What You See Is What You Get) interfaces that there is *intentional* blurring of this line.[3]

Likewise, the line between content and the life or living within which that content exists and functions need not be always clear and sharp. For example, when a friend posts a humorous anecdote about their preschool child on Facebook, it need not be clear *exactly* where the distinction between the anecdote as content (that is, EMC functioning) and the enjoyment of that anecdote and social connection (that is, HLC functioning) takes place.

However, just because these distinctions may be difficult to make at times in no way invalidates the suggestion that the distinction nonetheless exists. And, in practice, we shall see that even with occasional admitted difficulty in making the distinction between HCI, EMC, and HLC, the *usefulness* of making these distinctions is still demonstrable.

3 The introduction of WYSIWYG interfaces harkens back to previous computing eras, in which this distinction may have been sharper. When word processors for personal computers first appeared, the most common goal of creating a document was to create a printed copy; in that case, whatever appeared on the screen was a proxy – or an interface – for the content "in the computer" that would ultimately end up being printed. As more and more of the consumption of computing services moves online and on-screen, this becomes less sharp. The point at which the pixels on screen resolve into letters remains as clear as ever, but the point at which those letters resolve into meaningful content may be nearer to the interface than it used to be.

3.5.2 *Linguistic Approaches to Sign, Object, and Interpretant*

Some of the intuition behind the HUCF functioning categories echoes the work of Peirce (1998) in the field of semiotics, and the division of semiotic elements into Sign, Object, and Interpretant (pp. 407-409).

- In this case, Peirce's *sign* (or *signifier*) corresponds to the HCI category of functioning, as the interface is primarily symbolic in nature, mediating between the computer and the user. This corresponds with Basden's observation that the *qualifying aspect* of HCI is the LINGUAL.
- Likewise, the EMC category corresponds with Peirce's *object* element, which is what the program (or sign) is *about*.
- Finally, the HLC category has similarities to the *Interpretant* element in Semiotics, in that it is the category in which the question of "So what?" comes to the fore. That is, it is the *sign's* (or program's) *meaning* or *ramification* in the life of the person or people involved.

3.5.3 *HCI and EMC in the Model-View-Controller Paradigm*

The *Model-View-Controller* programming paradigm (Krasner & Pope, 1988) is a dominant programming paradigm in which a graphical interface is created by dividing a program's functionality into a *model*, which encapsulates information and behaviour about the underlying application domain, a *view*, which presents the desired information about the model to the user producing the program's output, and a *controller*, which allows the user to alter the state of the model, allowing for input to the program.

Because the the application domain is synonymous with the *content* of the program, the *model* in this paradigm corresponds to the EMC category of functioning, while the *View* and the

Controller together represent different types of HCI functioning. Thus, the Model-View-Controller paradigm echoes the same distinction between the content of an application and the user's interaction with that content that the HUCF does in distinguishing EMC from HCI. The *Model-View-Controller* paradigm does not address HLC.

3.5.4 *HCI and HLC in TAM Research*

The Technology Acceptance Model (TAM) is a dominant model in the information systems field for predicting and understanding user acceptance and adoption of various new technologies in the workplace (Davis, 1989). It is described much more fully is Sections 2.3 and 6.4.4. One of the key features of the model is to separate the notion of *perceived ease of use* from the notion of *perceived usefulness*. The former is about how quickly a new program can be learned, or how much effort (most often, cognitive effort) it requires to work with, while *usefulness* is about what difference it actually makes when you do use it.

Ease-of-use has a strong flavour of HCI functioning to it; although HCI includes more than the program simply being easy to use, that is one central feature of it. Likewise, *usefulness* is asking many of the same questions that are asked when considering HLC functioning, as it considers the way a particular application program may help or hinder the meeting of "real world" goals in the workplace. In this way, the TAM community has amply demonstrated some of the benefits that come from distinguishing between HCI and HLC.

3.5.5 *EMC and HLC in Computer Games*

Some of the research on computer games can be useful for demonstrating the validity of the distinction between content and impact. As one example among hundreds, Adachi & Willoughby (2011) discuss the relationship between the violent content of some video games and the human aggression it seems to engender. In particular, they critique some prior studies for claiming too strong a connection between violent content and aggression in everyday life. They claim that many of these studies do not do enough to differentiate the effects of the in-game violence from potentially confounding variables such as game intensity, competitiveness, pace, or difficulty. This is a clear example where the content of the game (the violence, in this case) is separate from, and yet clearly and intricately connected to, the larger human context in which the engagement with the content takes place. We can thus see that the distinction between EMC and HLC is recognised in this area.

While violence in computer games receives a lot of attention in both the popular press and the research community, it is certainly not the only life impact (HLC functioning) of computer games to be investigated by researchers. For example, *Entertainment Computing*, one of several research journals dedicated to the field of computer games and associated technologies, includes as one of its specific areas of interest "impact of entertainment technology on users and society" (Entertainment Computing Journal, 2014). In one article, Boyle et al. (2011) discuss a variety of impacts on the life of the players, including negative impacts such as violence, gender stereotypes, and addiction, but also positive impacts, like increased engagement, family closeness, mental health, and friendship networks. They then explore the ways in which the field of psychology can be recruited to help understand many such impacts, and explain the human functioning by which these effects occur. This again demonstrates at least one field researching an understanding of human use of computers that intuitively sees the importance of both the distinction and connection between content and impact, between EMC and HLC.

3.6 THE RELATIONSHIP BETWEEN HCI, EMC AND HLC

It is very appropriate to ask here, how are the three human functionings related? That is, how does functioning in one of the categories affect the functioning in the other two?

There are a number of possibilities, some of them, but not all, mutually exclusive:

- Each functioning operates independently, with no cross-influence between them.
- Influence flows "up": HCI affects both EMC and HLC, and EMC affects HLC.
- Influence flows "down": Properly envisioned HLC functioning will dictate the kind of content to embed in the EMC functioning of the program, and the content, properly understood, will point the way towards the appropriate HCI functioning to implement.
- EMC mediates influence between HCI and HLC: Any life meaning that results from HCI must be mediated by the content.

3.6.1 *Motivation for Understanding the Relationships: Responsibility for Proper Computer Use*

The Dooyeweerdian foundation of the HUCF provides for a unique concept of *responsibility*. At its core, the notion of responsibility is JURIDICAL in nature; that aspect deals with giving each its due, and with the rights and responsibilities that are entailed in doing so. But, because responsibility always involves the ability to shape circumstances or exert power to at least some extent (that is, it is the *ability* to *respond*) it also has a strongly FORMATIVE character.

While a person must have some ability to exert control in a given situation in order for the notion of responsibility to exist, one almost never has complete or total control. Thus some means for reasoning about the division of responsibility is necessary. In the particular case of computer and information systems, one helpful distinction to make with regard to responsibility is between the designers and programmers of a system, on the one hand, and between the consumers and users of that system on the other. This relationship comes up in the HUCF because of the unique roles that each of these parties plays in the different categories of human functioning.

- HCI functioning is largely determined at design time. The way the system reacts to key presses or mouse movements, and the nature of the outputs that are provided are set by the designer or programmer. Even though the user may have some choice about what inputs to provide, or how to respond to the program's output, these choices always exist within the prior constraints set by the designer of the system.
- In HLC functioning, the user is in the driver's seat. This begins with the user's choice of whether or not to use the system in the first place. The user holds primary authority and responsibility for the role that the computer system plays in their life. (Note that suggesting the user is most often the *primary* holder of responsibility is not the same as either suggesting that they *always* are, or that they are the *only* bearer of such responsibility. This will be further explored in Section 3.8.)
- EMC is the most complicated in this sense, as both the designer and the user are "present." Both parties must be considered when discussing how engaging with the content can be done normatively. The very name of the category, *engaging* with meaningful content, emphasizes that the user is important here. But, because the ways in which that engagement can occur are heavily circumscribed by the designer, responsibility for the EMC category of func-

> tioning to be normative also lies with the designer and programmer.

Although this discussion distinguishes between the designer and the user, in practise both of these roles can be played by the same person at the same time. For example, if a user creates a spreadsheet to keep track of their fitness goals and performance statistics, they are a *user* of the basic spreadsheet software created by the software company, but they are also both the *designer* and the *user* of their own fitness information system. In that case, the end user is the one who designs and implements the end computing product which contains their *content*, which they then go on to use. Because of the complexity of roles and relationships played by various parties, being able to track the complex normativities and responsibilities through this intricate web of relationships will allow the framework to ask important questions about to way computer systems are used.

3.7 NORMATIVITY IN HCI, EMC AND HLC

Normativity, in the Dooyeweerdian view, is part of the aspectual nature of reality. As discussed in Section 3.3, each aspect has its own distinct set of laws or norms. Norms are a way to think about aspectual repercussions, using an if/then construct. If we obey the ECONOMIC norm of frugality, then we can expect benefit, such as enough food to last the winter. If we disobey the SOCIAL norm of respect, then we can expect detriment, such as isolation and loneliness. The norms do not operate mechanically, like determinative laws in the earlier aspects, but as part of the larger, multi-aspectual picture of human life.

Dooyeweerdian scholar Goudzwaard (1979) describes norms:

> "The purpose of norms is to bring us to life in its fullness by pointing us to paths which safely lead us there. Norms are not straitjackets which squeeze the life out of us. [...] If man and society ignore

> genuine norms, such as justice and restitution of rights, respect for life, love of neighbour, and stewardship, they are bound to experience the destructive effects of such neglect. This is not, therefore, a mysterious fate which strikes us; rather, it is a judgement which men and society bring upon themselves." (Goudzwaard, 1979, pp. 242-243)

The question this section asks is: How do the normativity of each of the three human functionings interact with each other? For example, how does normative (or non-normative) functioning in HCI affect the normativity of functioning in HLC?

3.7.1 *An Example*

For an example, consider the following situation: A university student is spending several hours a day in an online multiplayer game, advancing through the ranks and making many virtual friends, but to the detriment of her studies. To evaluate the normativity of this computer use, we can start by looking at how the three different categories of functioning with computers work in each of the Dooyeweerdian aspects of reality. For example, with the university student absorbed in an online game, the AESTHETIC aspect of the HCI functioning is well done. The company that produces the game has gone to great pains to ensure that the interface is not only nice looking, but functions harmoniously to the extent that the interface seems to disappear and the control of the game becomes a simple extension of the user.

For a second example, we'll consider the case of the professor sending grade reports using a "mail-merge report" with spreadsheet and word-processing software. This was briefly introduced above, and will be analysed using the HUCF in Section 5.1.

We can then ask: "How does the normativity (or non-normativity) of functioning in HCI and EMC affect the normativity of the HLC category of functioning?" The following two sections each presents a different simplistic hypothesis to describe the relationship, neither of which turns out to be tenable.

3.7.2 *First Attempt at Understanding the Interplay: HLC Leads*

Because HLC is the broadest and fullest kind of functioning – its meaning is embedded in the meaning of our every-day lives – it is the category of functioning that has the greatest impact on our selves and our society. In both of the examples above, to evaluate the overall normativity of that particular use of a computer system ultimately requires us to evaluate how well it functions in HLC.

As a first hypothesis to describe how they interrelate, we could suggest a simple hierarchical relationship: "*HLC is the thing that ultimately matters, and good HCI functioning encourages good EMC functioning, which in turn encourages good HLC functioning*." Or even more generally: "*HLC is what ultimately matters, so any effect that the normativity of HCI and EMC must have in the 'real world' must be mediated through HLC functioning*."

There is doubtless some truth to these hypotheses. That is, when standing alone, HLC is generally the most important of the three functionings and much of the way HCI and EMC play out their roles is indeed through the results they produce in HLC. But HLC is not the *only* thing that matters, and *much* is not the same as *all*.

In addition, HLC is *affected* by, but not *determined* by, HCI and EMC. That is, the examples will demonstrate that normative HCI and EMC functioning do not always lead to normative HLC functioning, and cases show poor functioning in HCI that does not appear to inhibit normative functioning in HLC. Thus, to evaluate the full normativity of a situation, we need to look at how HLC functioning is working without limiting our analysis to only how it is affected by HCI and EMC functioning.

3.7.3 *Second Attempt at Understanding the Interplay: HCI First*

A second attempt to describe the relationship, which I refer to as the physicalist approach, could be that HCI is the only functioning that has its basis in physical reality, and that therefore, it is the one on which all other functioning ultimately depends. That is, only the HCI functioning can be explained by beginning in terms of molecules and energy, and therefore, without physical hardware, and an interface with which the human user can actually interact with the computer, no engaging with content or living everyday life with the computer could occur.

Again, this explanation does contain some kernel of truth. Reality is inescapably physical. However, the Dooyeweerdian foundation of the HUCF rejects the reductionism implicit in this stance entirely. While the framework recognizes that reality is inherently PHYSICAL, it is also inherently PSYCHOLOGICAL, SOCIAL, ECONOMIC, etc. The 15 Dooyeweerdian aspects cannot be reduced to each other, and all are meaningful simultaneously. Because all of the functionings must encompass all of the aspects, the status of HCI as the functioning that is implemented physically in hardware does not lend it any special importance or priority in general.

Thus, while recognising the insight that HCI is, in some sense, *foundational* to the other functionings, all three functionings are simultaneous and interdependent, and cannot be reduced to just one.

3.7.4 *Counter Examples*

To see why the above simple hypotheses can't be the whole picture, we can look at some counter examples to these statements, in which, for example, excellent HCI functioning does not lead to normativity in HLC, or that poor HCI functioning need not eliminate the possibility of proper HLC.

STUDENT ABUSE OF ONLINE GAMING As a first counter-example, consider the case of the student pouring hours of time into her online game. The game is meticulously designed, programmed, and produced, and the HCI of the game is just superb by all accounts. In other words, the HCI functioning is mostly normative in all of the aspects. It communicates the represented content so fluidly that it doesn't feel like an interface at all. It is simply an extension of the user. In addition, the meticulous graphics (the SENSITIVE and AESTHETIC aspects) do great justice to the realism of the represented enemy creatures, and the social relations between the various other users and computer-controlled monsters are well represented. In other words, the EMC of the game is highly normative in most aspects[4].

If the simple hierarchical relationship outlined above were the only rule in force, then, we would expect the excellent HCI to help make EMC more normative, which it arguably does, and the very good HCI and EMC together would promote normative functioning in HLC. However, this is not the case. Our hypothetical student is so engrossed in the game that her studies, relationships, and even her health have all begun to deteriorate. The computer/information system that is the online game is not contributing to more normative functioning in the rich diversity of meanings in her human life:

- She is not *flourishing* BIOTICALLY.
- Despite the frequent "rush" associated with some particularly exciting situations in the game, she is not overall

4 In this particular case, one could wonder about how well the ETHICAL is represented in world, as the primary goal of the game is to kill other beings. That discussion is, however, beyond the scope of this thesis.

feeling happy, energetic, and alive in the PSYCHIC/SENSITIVE aspect.

- She is not making good, clear *distinctions* between reasonable leisure pursuits and harmful obsessions in the ANALYTIC.
- In the SOCIAL aspect, while she is building genuine, meaningful *relationships* with her online *peers*, she does so at the expense of ignoring (and thus *disrespecting*) the other people in her life, including room-mates, classmates, professors, and family.
- AESTHETICALLY, she enjoys the beauty and fun of the game, but at an intensity which challenges the *harmony* of the rest of her life — it's an *imbalance*.
- ECONOMICALLY, she is making poor choices regarding the use of very *sparse resources* — her time and energy.
- In terms of JUSTICE, her game play takes more than *its share* of her life/energy, resulting in *injustice* to all of the other people and tasks which subsequently are ignored or rushed.
- ETHICALLY, her use of the game is *selfish*; it provides pleasure for her while not contributing anything to others in her "real life". (She may, however, be acting in an *ethical* and *caring* manner with the other persons/players in the game world.)
- PISTICALLY, in terms of living in *good faith*, living out her *vision of who she wants to be*, and what she places her ultimate *trust* in, the online game shuts out much of *the kind of person* she wishes to become.

In fact, not only do we have an example of good HCI/EMC functioning not resulting in good HLC functioning, I argue that increasing the quality of functioning in the HCI and EMC categories may very well *worsen* the already-abysmal functioning in HLC. For example, if the interface moved from a keyboard, mouse, and monitor situation into a fully immersive virtual reality, it's difficult to imagine that this would tempt her *less* to devote an unhealthy amount of time to playing.

PROFESSOR SENDING STUDENT CURRENT GRADE REPORTS The second example uses the case in which the mail-merge features of the Microsoft Word and Excel programs are used to send students an up-to-date snapshot of their current grade. This example is somewhat less clear in terms of judging the overall normativity, with some normative functioning and some non-normative functioning in the various functionings. Of particular concern is the PISTIC aspect in both EMC and HLC functioning, in which the mechanical nature of the process can bleed into adopting a mechanical view of the instructor's role. However, the preponderance of normativity in the SOCIAL through ETHICAL aspects of HLC (SOCIAL respect for students, ECONOMIC time savings, avoiding nasty [AESTHETIC] surprises, JURIDICALLY just to students, and ETHICALLY above and beyond what would be required) seems to win out and seems indicates a normative activity in HLC as a whole[5].

3.7.5 *Analysis*

HCI, EMC and HLC are forms of human functioning. The focus of the HUCF is, obviously, on the user of the computer, primarily at the time of use. However, that emphasis does not preclude recognition that the functioning is much more directed by the design of the computer in HCI, and to a lesser extent EMC, than in HLC. So, in examining the interplay of norm-

5 Note that I don't meant to suggest anything like an *Aspectual Calculus*, in which we can add up the normative functioning and subtract the non-normative functioning to get a final normativity score. Instead, "Simultaneous realization of the norms" requires a harmony among norms that, at first glance, may appear to be in conflict in a particular situation. But even without such a normativity sum, it is still sensible to talk about the overall situation being more or less normative.

ativity in the computer-oriented side (HCI and EMC) and the human-centred side (HLC), we have eight possibilities. (This binary "normative or anti-normative" distinction may not do justice to the nuance of individual cases, but in trying to reason about the nature of the relationships, it may be provisionally helpful.)

1. Normative functioning in HCI and EMC results in normative HLC functioning becoming even better.
2. Normative functioning in HCI and EMC results in normative HLC functioning becoming somehow worse.

3. Normative functioning in HCI and EMC results in anti-normative HLC functioning becoming not as bad.
4. Normative functioning in HCI and EMC results in anti-normative HLC functioning becoming even worse.

5. Anti-normative functioning in HCI and EMC results in normative HLC functioning becoming somehow better.
6. Anti-normative functioning in HCI and EMC results in normative HLC functioning becoming not as good.

7. Anti-normative functioning in HCI and EMC results in anti-normative HLC functioning becoming not as bad .
8. Anti-normative functioning in HCI and EMC results in anti-normative HLC functioning becoming even worse.

Notice that in any given situation, only one possibility from each pair can be true. If one is the case, then two is not. If six is happening, then five cannot be.

First, consider possibilities 2 and 5. In the case of possibility 2, if HCI, EMC and HLC are all functioning normatively, it is difficult to imagine how the earlier two would have a negative effect on the later. For example, consider the situation where a group of young adults is gathered around a game console enjoying a multi-player game. The game is fun, the interface is intuitive and beautiful, the graphics are realistic, and there is camaraderie and laughter in the air. In other words, HCI, EMC and HLC are all functioning normatively. Possibility 2 suggests that further improving the functioning of HCI and EMC might actually cause the HLC functioning to be poorer. If the HLC is functioning normatively, it may be *despite* poor functioning in HCI and EMC, but not because of it. It seems absurd to suggest, as in possibility 5, that *reducing* the normativity of HCI (making the interface ugly, confusing, or costly) would somehow make the HLC functioning even better.

Next, we examine the four common-sense possibility possibilities, 1, 3, 6, and 8: Normative HCI and EMC functioning improves HLC, and anti-normative HCI and EMC functioning damages HLC functioning. As an example, the HCI functioning in the case of the mail-merged grade reports is quite clunky (Table 4). The generation of the grade reports is optimised primarily for numeric data and small, calculated fields. Sending extensive personal comments is difficult and time-consuming. As a result, the EMC functioning (for example, in the QUANTITATIVE, ANALYTICAL, or LINGUAL aspects) is pushed towards a more mechanical, grade-driven view of the teaching task, which then comes to fruition in the PISTIC aspect of HLC functioning. Thus, while the overall normativity of the activity is well done, we have an example where problems in HCI and EMC result in detriment in HLC functioning.

The situation with anti-normative HLC functioning is more complex, however (possibilities 3-4 and 7-8). Remember, for example, our game-playing college student. The HCI and EMC functioning of the game she's playing are very well done. The graphics, interface, and game design are all exquisite. However, this doesn't alleviate the anti-normative functioning in HLC – it exacerbates it! If the interface were less well done, the gameplay experience might well be less addictive. Thus, we conclude that possibility 4 is the correct one in this case.

Alternately, in a situation where the HLC normativity of using a computer system is already compromised, we might think that non-normative functioning in HCI and EMC would make it worse (possibility 8). This need not be true. Think, for example, of the early data-processing capabilities used in Nazi Germany to assist with significant data-processing challenges involved in carrying out the horrors of the holocaust (Black, 2001). A more efficient interface, more intuitive data-entry, or easier-to-understand reports wouldn't have improved the anti-normative HLC functioning in that case, but would have aggravated it. The primitive HCI and EMC functioning available at the time led to delays and inefficiencies, saving lives that might otherwise have been lost. As this case makes clear, the anti-normative HLC functioning can be anti-normative independently from the the HCI and EMC functioning. In that case, improving the HCI and EMC functioning would, ironically, make the HLC situation even worse. This is an example of possibility 7.

From looking at these examples and reasoning through them, we arrive at these descriptions of the normative relationships:

- When HLC functioning is normative, anti-normative HCI and EMC functioning would hinder it, and so normative HCI and EMC functioning would make it even better. (Possibilities 1 and 6 above, as in the overall case of a professor sending grade reports, or the group of young adults playing a social video game.)
- When HLC functioning is anti-normative, and this anti-normativity is due, in part, to anti-normativity in HCI and EMC then addressing the problems in HCI and EMC will help to improve HCI functioning. (Possibility 8, as in the PISTIC aspect of the professor sending grade reports case.)
- But when HLC functioning is anti-normative for reasons independent of the HCI and EMC functioning, then improving the functioning in the HCI and EMC categories will actually make the HLC functioning even worse! (Possibility 4, as in the example of the game-playing student, and possibility 7, as in the example of Nazi data processing.)

3.7.6 *The Shalom Principle*

The Shalom Principle (introduced in Section 3.3) suggests that when we function in a normative way in all of the aspects, the result is shalom — a deep, rounded, rich well-being. Violating the laws and norms of any aspect jeopardizes this shalom. In the example of sending grade reports by email, each of the three multi-aspectual functionings has some normativity and some non-normativity in various aspects.

The shalom principle would suggest, for example, that improving the economic and aesthetic normativity of HCI will bring the whole of the functioning/experience into greater harmony and richness. And in this case, that's easy to see. A smoother, easier-to-use mail-merge process would make the entire exercise a lot quicker, more efficient, and more satisfying. This in turn, could have repercussions in the HLC column. For example, in the ETHICAL aspect, in which sending out regular grade reports is an example of self-giving and going beyond what is strictly due, a better HCI functioning might encourage me to send them more regularly than I do, or to incorporate additional information and individualized feedback.

On the basis of the above analysis, I suggest that this same shalom principle can extend to both dimensions of the HUCF. Not only does normative functioning in each aspect benefit from the normative functioning in all other aspects, but the same is true for the HCI, EMC, and HLC functionings. Only when all three are functioning normatively will the total computer use situation be fully optimal. This may seem a rather obvious insight, but the implications are profound. In particular, if functioning is not normative, then it is crucial for programmers and designers to understand *why* that functioning is not normative. If the reasons are unrelated to functioning in HCI and EMC, then great care must be taken that any improvements to HCI or EMC do not, in fact, exacerbate the existing problems in HLC. Because designers and programmers are often not used to considering their role in the HLC functioning of the user, this is an important consideration.

The multifarious nature of normativity in the aspects makes the aspects an excellent tool for analysing breakdowns in overall normativity, and searching for ways to repair that.

Responsibility for normative use must lie with human beings, as inanimate objects like the computer are subject to the laws of the earlier aspects (QUANTITATIVE through PHYSICAL), but not to the norms of later aspects (such as the LINGUAL norm of *clarity*, the ECONOMIC norm of *frugality*, or the AESTHETIC norm of *beauty*). But, it is not always entirely clear where the human responsibility lies between the user and the developer. The next section will explore a construct that can help to clarify this.

3.8 SUBJECT BY PROXY

In this section, the question of where responsibility lies in a computer use situation will be explored through a series of thought experiments. Throughout this discussion, the word "responsibility" is used in a Dooyeweerdian sense, as the requirement to function in response to the law-side of the various aspects of meaning. For the later aspects, this means functioning according to the various modal norms. While words like "blame" or "credit" are often a rough analogue to "responsibility", the Dooyeweerdian way of looking at it is much richer, and based in the concept of *shalom*.

The question of responsibility, first brought up in Section 3.6.1, is important because of the distinction between the abilities of the user and the designer in shaping how the computer system is used. While the designers and programmers of a computer system clearly bear some responsibility for its normative use, the creator of the software is no longer actively present at the time of use, while the user certainly is. In order to still maintain some notion of responsibility for the programmer, we will require some mechanism by which the responsibility of the software implementer extends through time past the point where the design decisions were made to the time when the software is used. Without such a mechanism, it is much more difficult to reason about how the designer can hold any responsibility for use at all. As originally presented, the HUCF does not consider this question.

A number of examples and thought experiments are given below to help consider the way in which human responsibility is expressed through various technical/cultural artefacts.

3.8.1 *Examples of the Distinction*

Because sophisticated computer software can seem to have an agency of its own, computer systems make a particularly difficult starting example when reasoning about division of responsibility between the designer and the user of technological artefacts. For that reason, this section begins with several non-computer examples of technology, where it may be easier to see how the division of responsibility works. Translating these insights into the computer use situations will be done later in this section.

3.8.1.1 *The Hammer*

First, consider a simple, direct tool, such as a hammer, from the perspective of two parties, the creator of the hammer, and the user. The creator of a hammer certainly has a number of responsibilities in creating the tool properly, including ensuring that it is of sufficient quality to be used safely. But when it comes to the actual use of the hammer, I propose that the vast majority of the responsibility lies with the end user of the tool. The reason for this is that the design of a hammer is relatively simple and straightforward. It is thus reasonable for the creator of the hammer to assume that the user will be able to perceive the majority of possible benefits and dangers involved in its use. And, even if the danger of self-injury isn't obvious from a quick visual inspection of the design of the hammer, there is a significant shared social/cultural understanding of this danger. Consider, for example, the cartoon cliché showing the aftermath of hitting one's thumb with a hammer.

This is not to say that even simple technology like a hammer is value-free. For example, it is likely to nudge the user towards solutions that involve pounding rather than more nuanced, delicate approaches. An aphorism commonly attributed to Abraham Maslow states that "When your tool is a hammer, all of your problems begin to look like nails." And there may be genuinely hidden dangers, such as vibration induced injuries, or materials that may shatter on impact with small projectiles causing eye damage. But on balance, the vast bulk of responsibility for use of the hammer lies entirely on the shoulders of its direct user.

3.8.1.2 *Power Saw*

Staying with the theme of construction equipment, let's now consider an electric-powered circular saw. The assumptions we could make about the hammer no longer hold. Despite the seemingly obvious nature of the dangers of using this power-tool, a significant number of people are injured by using one incorrectly or injudiciously, suggesting that the true dangers of using the equipment are either not as obvious as it might seem, or very easy to rationalize away. Therefore, the designer-/creator of a circular saw bears more responsibility for how the device is used than the designer of the hammer. Design choices need to be made that minimize the danger without inordinately affecting the usability of the equipment. Use of blade guards, inclusion of a safety feature requiring that the on-switch be held down by the thumb of the user, and other safety features are forms of such design choices.

This is not to suggest, however, that *only* the creator of the tool has this responsibility. Clearly, the user of the tool also bears responsibility for its safe use, and much more so than the creator. If the designer has made prudent design choices and has implemented well-designed safety features, then they have met their responsibilities, and bear very little blame if the user foolishly overrides or disables the safety features and injures himself.

3.8.1.3 *Assault Rifles*

Because of relatively lax regulations on firearms in the United States, it is legal for private citizens in many jurisdictions to own military-grade assault rifles, such as the well-known AK-47. As a result of this, the AK-47 seems to the favoured weapon in mass-shooting massacre attacks in the United States. In a situation as horrible as a mass murder, there is obviously a lot of need to determine where responsibility and blame lie.

Clearly, significant responsibility for such an atrocity lies with the perpetrator of the act, who exercised his[6] own volition to commit the crime. (Though reliable statistics are nearly impossible to produce, it seems reasonable to expect that a sizeable percentage of such criminals suffer from a mental illness of one kind or another, which may or may not relieve them of at least some of their moral culpability for the crime.)

But, beyond the obvious and central responsibility belonging only to the one pulling the trigger, we have to ask: Do any others bear any responsibility for the act? An aphorism common among gun-ownership-rights supporters states that "Guns don't kill. People do." The clear implication is that only the user of a weapon bears responsibility for the results of their actions, that no latent responsibility resides in the artefact itself. But the aphorism is a dogma. The designer of the weapon and

6 Though I strive to maintain a gender-neutral prose style, in which the gender of generic subjects alternates with use, in this case the statistical preponderance of mass-shootings being committed by males makes it reasonable to specify that our hypothetical shooter is, indeed, a man.

those involved in its manufacture must have been aware of its vast potential for immoral usage. Parliaments and congresses create a legislative and regulatory framework in which guns can be produced, traded, and sold. Law-enforcement agencies are charged with implementing any such restrictions. There are also a wide variety of cultural influences which conspire to create an environment where violence seems to be an acceptable solution. Each of these people also bears some responsibility for the atrocity, though such responsibility is diffuse, being shared across a distance of time, space, and causality with many other stakeholders.

3.8.1.4 *Typewriters*

So far, we've only been considering the safety in the use of various technological artefacts. There are obviously many more features that involve moral imperative beyond just safety. Technology is not neutral, and our choice of tool intrinsically affects how we do our work. To what extent does the creator of a tool bear responsibility for these changes? For example, when Friedrich Nietzsche switched from handwritten manuscripts to the use of a typewriter, it made a noticeable difference in the quality and nature of his prose (Kittler, 1999, p. 206). Is it fair to ascribe any of the responsibility for this change to the creator of the typewriter? In order to do so, we would need to postulate some mechanism whereby such responsibility could continue to be held by the designer and manufacturer even when the device is no longer in their hands.

3.8.2 *Axes of Responsibility*

It may be helpful to think of the responsibility that we carry (across all aspects) in two dimensions. The first dimension simply has to do with how much (and, perhaps, what kind of) responsibility an individual has in a given circumstance. This could be exemplified by the examples of the hammer and the power saw above, where the designer must assume more responsibility in the design and production of the power saw than of the hammer. The second axis of responsibility is that of proximal versus distal responsibility. Consider the hammer and the power saw again. In both cases, the designer is quite distant from the action that takes place when it gets used, while the user is in close proximity to it. Thus, the user has highly proximal responsibility. Note, however, that the *amount* of responsibility is not directly tied only to proximity; the designer is equally distant in both cases, but bears more responsibility in the case of the power saw.

In each of these situations, there was always a proximal user who could serve to bear responsibility for the use of each of these tools. But how can we reason about this when there is no proximal user? That is, when the tool is capable of "acting by itself", after being set in motion by a human being.

3.8.2.1 *Animal Trapping*

Consider the 19th century practice of trapping animals using a steel-spring trap. When the trapper placed the trap and set the spring, clearly he bore responsibility for that action. However, at the time when the trap would spring, the actual working of the trap was no longer proximal — it was not under the direct guidance of the user. It seems common sense that when the trap was sprung some hours later, the responsibility still lay with the trapper who set it. However, to reason thus, we must assume some mechanism by which responsibility extends beyond the proximal use to the distal relationship the trapper now has with the trap.

3.8.2.2 *Roller Coasters*

And even when there is a proximal user, a distal relationship need not always imply a lower level of responsibility. Consider, for example, the safe use of an amusement park ride. While the designer has a distinctly distal relationship to the use of a roller coaster, he in fact has significantly more responsibility for its safe use then the proximally related rider of such an amusement. This is because it would be unreasonable to expect each individual user to be knowledgeable about all of the various possible dangers that could exist on the ride, and to evaluate the design for safety before getting on. The designer, on the other hand, would be expected to do exactly that. Again, we can see that some form of responsibility is being exercised by the designer across the space and time between the design and production of an artefact and its use.

3.8.3 *Computer Software*

A computer is a technology that is characterized as being able to run by itself after it has been set in motion by a human. This "setting into motion" is what the process of programming is all about. In this sense, when a user interacts with a computer, they are really interacting with the intentions of the programmer(s) over a distance of time and space.

So, we must consider the responsibility that a programmer bears in the execution of her program. In many cases, when the software is interactive, there is a user who bears primary responsibility for the results of usage. The creator of a word processing program, for example, can hardly be held primarily responsible for the hurtful words that a user writes with the program. On the other hand, if there are features of the software which seems to lend itself especially for writing hurtful words, as one might at least suggest is the case for online communities where "flaming" on public forums is common, perhaps the responsibility of the programmer isn't so minute as we might think at first glance.

However, there are other applications in which the intent of the programmer is embedded in a software product, and continues to run on by itself with little or no additional user interaction. Take, for example, a programmable thermostat. Once programmed and set in operation, it runs by itself, automatically adjusting the temperature based on day of week and time of day, with increasingly sophisticated options available for automatically choosing the optimal ventilating, heating, or cooling based on outdoor temperature, humidity, and other factors. Note, however, how distant the original programmer is from the actual use of such a product, while still having a great deal of responsibility for its operation.

When Predictions Cannot Be Made

In the programmable thermostat example, the system is deterministic enough that a competent programmer can make fair predictions about the performance of the system. Consider, however, applications in which that is not the case. For example, when artificial intelligence technology advances sufficiently, we will reach a point where the next generation of a software program can be written by the current generation of software. After several iterations of that process, the original human programmer of the first generation AI system will be extremely distant from the resulting intelligent agent, and will have virtually no ability to predict what kind of system might result. How does her responsibility carry through to the final product? How can it? There are three potential answers to that question:

1. Recognizing their inability to sufficiently guarantee normative behaviour by a resulting system, a truly responsible programmer would refuse to create a program capable of writing its own next-generation replacement.
2. The human responsibility held by the original programmer is diffused in an almost genetic fashion through all

of the machine-produced generations of software that follow, and resides in the final product.

3. At the point at which a machine has enough complexity and intelligence to program its own next-generation replacement software, responsibility emerges from the complexity, and it takes on moral agency on its own.

Regarding the first possibility, this may be philosophically and ethically defensible, but practically, determining the exact point at which responsible software development ceases to be a possibility would be nearly impossible. In addition, this position seems unlikely to be adopted by the majority of computer practitioners. Thus, we must consider ways to address how responsibility would work in such situations, when human agency is greatly removed from the working of the final product.

Regarding the second possibility, this is an attractive option in a number of ways. However, the nature of the mechanism by which responsibility could "genetically" flow from programmer to software is difficult to define. In addition, in this case where there is no ability for the original creator to either predict or control the nature of the final product, the phrase "human responsibility" begins to mean almost nothing at all.

Regarding the third possibility, it is difficult to imagine what emergent responsibility might look like, or what could be meant by the phrase "moral agency" when it applies to technological artefacts. It seems clear that it would not necessarily mean *human*-like responsibility or morality. More philosophically, strict adherence to Dooyeweerd's notions of subject/object functioning would force us to reject this possibility. That is, as a non-human, the executing program (i.e. hardware/software combination) can not function as subject in the modal aspects past the PHYSICAL. Exploration down this path can certainly take place, but it will need to do so by moving beyond Dooyeweerd.

Because possibility one is untenable, we can try to look for a hybrid of possibilities two and three that avoids the pitfalls of each.

The Subject-by-proxy Proposal

Basden (2008) suggests that we can think of software as a Dooyeweerdian "law-side for the virtual world" of the executing program (p. 197). That is, just as Dooyeweerd posits that all entities in reality function according to the laws/norms for the aspects, and it is these laws that allow reality to exist and occur, so the programmer can create their own laws for the virtual entities that occupy the virtual "world" of their program – i.e., the content. This is easiest to envision for situations of virtual reality, games, or simulations, in which we can imagine various entities interacting according to the "rules" established by the programmer. However, there is no reason in principle that the same approach fails when the "virtual entities" are cells in a spreadsheet rather than agents in a simulated world. Note that though the specifics within the executing program are thus functioning as subject in some aspects of this set of laws, these are all within the virtual world, not within the real laws/norms of human subject functioning.

So, while virtual entities within the computer do not act as subject in any aspect beyond the PHYSICAL in reality, they can be subject to all of the norms and laws, including for later aspects, such as ECONOMIC, AESTHETIC, or JURIDICAL, in the virtual world of the program.

By this observation, we can begin to envision a way in which responsibility could be inherited by running programs from the programmer. To be responsible is to respond to the norms in all the aspects, and only humans can do that. But, if the human programmer creates a virtual world with its own lawfulness that the computer program will then "obey" in execution, then the programmer's responsibility can be inherited by the software to the extent that the virtual reality and associated laws and norms that the programmer creates comport well with the laws and norms of the actual aspects. The developer exercises their responsibility by creating a system which will behave normatively after the developers' participation is no longer active.

I call this functioning "subject-by-proxy," as the computer entities are not actually subjects in the later aspects, but can take on some of the subject functioning as a proxy for the programmer. In the case of the multi-generation artificial intelligence software, the responsibility of the programmer is to create a (virtual) reality in which the assessment (and thus acceptance) of future generations of the software is based on real norms.

The benefits of the "subject-by-proxy" concept is that it:

- gives us a way of recognizing the distal nature of the responsibility the programmer has for the way her programs are used after they have been "let loose" in the world
- maintains that only humans can function as subjects in the higher aspects
- emphasizes the long-term potential impact that a running program can have
- encourages the programmer to *delegate* her responsibility to the computer with great care.

Thus, thinking of how the program will function as if it were a subject in the higher aspects can help us consider how the program will function normatively in those aspects, without losing sight of the fact that it is the involved human beings (corporately) that must bear the responsibility for the results.

As programs and program development become increasingly sophisticated and the distance between programmer and result grows, this increases rather than decreases the importance of taking steps to ensure normative functioning of the resulting information system.

3.9 SUMMARY

Summing up this introduction, it is worthwhile to emphasise a number of characteristics that have emerged:

- Aspects are good tool for understanding diversity.
- The three human functionings need to be understood separately.
- Both aspects and the human functionings have inherent normativity
- There are multiple kinds of relationship between the human functionings.
- This framework can appreciate other approaches to understanding computer use, and can help understand why some problems may not be well understood by existing approaches.
- Dooyeweerd's notion of subject and object may not be nuanced enough to intuitively understand the nature of responsibility over distance.

These characteristics will be demonstrated implicitly in the results of Chapters 5 and 6, and revisited explicitly in Chapter 7.

The HUCF framework presented and extended in this chapter is promising, but has only been proposed, and has not yet been tested in much actual use beyond Basden's 2008 book. The main purpose of this thesis is to provide such testing. The next chapter, on my research approach, will describe and defend the methods by which this will be accomplished.

4

RESEARCH APPROACH

This chapter introduces the approach I have taken in this research. This begins with a discussion of what it means to test or assess a framework, and how this differs from the more familiar task of testing a theory. With this as background, Section 4.3 introduces the underlying research philosophy, and the strategy used to meet the research objectives is described in Section 4.4. The actual techniques and procedures used to implement that strategy are provided in Section 4.5.

4.1 ASSESSING A FRAMEWORK

"A Framework For Understanding (FFU) an area is a way of seeing an area" (Basden, 2008, p. 11). It is a conceptual apparatus that people can use to think with, and thus influences how we classify things, what kinds of theories we develop, how we formulate these theories, what methodologies we use to perform our research, what we see as important, what kinds of questions we ask, and what we see as problematic.

Because of the nature of a framework as a set of pre-theoretical beliefs and assumptions, it makes no sense to ask whether or not the framework is *true*. Rather, what we ask of a framework is that it be *fruitful*. What is meant by a framework being *fruitful*? It means that the framework does well what it is supposed to do, and in so doing provides benefit or utility to its users. (This use is commensurate with the everyday meaning of the word, as applied, for example, to a fruit tree in an orchard.) Because a framework for understanding is a *tool for insight*, its fruitfulness will be demonstrated on the basis of its ability to produce insight. The exact nature of this insight is discussed in greater depth in Section 8.2.1. In brief, it means a problem can now be solved more satisfactorily because a new way of seeing the situation has been used.

Thus, demonstrating the fruitfulness and utility of the framework can be achieved by demonstrating its ability to produce insight. This, in turn, can be demonstrated by applying the framework to concrete, problematic situations and showing that fresh insight emerges. Thus, the testing of the framework necessarily requires its application to difficult problems to see whether, indeed, fruitful insight emerges. The issue of computers and procrastination is such a situation, and will be the primary example used to test the framework.

It may help to adopt a simple analogy of testing a vehicle. When you test a car, you don't test it for *truth*; that doesn't have any meaning. Rather, you test it for usefulness. Some of the tests you my wish to run are more formal in nature, such as determining how powerful the engine is, or whether it meets emissions standards. But the more intuitive, and convincing, test is to simply take it out for a drive. A proper test drive will take the vehicle over a variety of terrain it may be expected to meet in regular use, and will provide potential purchasers with information about how well the car will help them out in their everyday transportation tasks.

Testing a framework is similar; the goal is to determine, when the framework is put to use in "real world conditions", how does it do? Is it fruitful in producing insight? Is it easy to use? Does it address the everyday experience of the user? Performing this kind of test-drive of the Human Use of Computers Framework (HUCF) is the task of this thesis.

Assessing a framework is thus unique from many other types of research, though it does borrow from the assumptions and techniques of some of them. This section compares framework assessment to a number of prominent research paradigms, and show why it doesn't fit into them. The following section will look at a broader array of research philosophies, and show which aspects of each are incorporated into the research methods used in this thesis.

4.1.1 *Compared to Theory Testing*

Many PhD theses are designed to test a theory or a hypothesis. To the extent that it makes sense to talk in terms of *theories* and *hypotheses* when analysing conceptual frameworks, my hypothesis is that "The HUCF is a useful framework, and will produce fruitful insight when used to analyse computer use situations." However, a conceptual framework is pre-theoretical (see Section 2.2), which means that it "cannot be proven correct or incorrect by theoretical means because it is held as a pre-theoretical commitment as a set of beliefs and assumptions" (Basden, 2008, p. 13). Thus, using the language of theories and hypotheses is likely to be misleading. Instead of testing a hypothesis, the work is to assess the framework itself.

The research objectives, listed in Section 1.5.2, demonstrate an approach that is appropriate for a testing a pre-theoretical framework, in which the terms of the objectives themselves assume some of the same normativity as the framework.

For example, Objective 1 calls for the demonstration of "insight into the problem." This would not be a justifiable objective for a theory because the theory would rely upon some notion of what qualifies as appropriate insight. This in turn requires a pre-existing commitment to a view of what is a desirable outcome, and that must come from outside the theory itself. But, it is a perfectly appropriate objective for a *conceptual framework*, insofar as a framework can only ever be measured in its own terms. A framework must be *coherent*, that is, consistent with its own principles and goals (DeRoo, N. 2013, personal communication, 3 July). The Dooyeweerdian foundation of the framework, with its diverse normativity, provides a robust scheme for considering both the internal self-consistency of the framework and evaluating the usefulness and fruitfulness of the resulting insight.

4.1.2 *Compared to Interpretive Research*

Interpretive research "focuses particularly on human interpretations and meanings" (Walsham, 2002, p. 101). Such research cannot make a priori assumptions about what is meaningful, precisely because it is looking for the meaning that subjects ascribe to events. A philosophical framework, however, does make such claims and assumptions about what is meaningful. It therefore does not work well within an interpretivist paradigm. The HUCF, and in particular the EMC category of functioning, certainly takes into account the interpretations and meanings of users, but it is not specifically well-suited to searching out these interpretations on its own.

4.1.3 *Compared to Critical Research*

Critical research "aims to transform ... alienating and restrictive social conditions" (Myers & Klein, 2011, p. 19). However, in order to do this, critical research tends to assume that the status quo is inherently flawed, and that these flaws must be exposed and rooted out, so that emancipation can be achieved. While the framework shares with critical research a commitment to a vision of *better*, it does not assume that the status quo is, necessarily, oppressive and in need of overthrow rather than amendment and refinement. The HUCF is thus not critical in the sense that it focuses on a single "wrong way" which needs to be critiqued and addressed. Instead, the framework promotes a larger vision of flourishing and richness in the use of computer systems.

4.1.4 *Compared to Design Science Research*

A design science research methodology, is something of an outlier among research methodologies, with connections to action research (Järvinen, 2007). It is gaining a small following in the information systems research field (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007). Design science research seeks to encapsulate an understanding of reality not in thesis statements, but in working artefacts. "[Research through design] is an inquiry process revolving around the making of a product, service, environment, or system, the knowledge gained can be implicit, residing almost entirely within the resulting artefact" (Zimmerman, Stolterman, & Forlizzi, 2010, p. 310). In some ways, this paradigm is a close fit for testing a framework, as the framework itself is an *artefact* of a sort. If this thesis were to adopt a design science research methodology, the goal would be to demonstrate, by use, that the resulting artefact (the HUCF) comports well with temporal reality. This is fairly close to the actual approach taken.

However, thinking of the framework in these terms seems to be stretching the notion of artefact some, as the framework is much more abstract than a typical tool or artefact. Although the framework is referred to as a "tool for insight", it is not a tool in the conventional sense. A tool is designed to accomplish some particular goal, while the framework being used is part of what determines which goals are worthy of pursuing in the first place.

4.2 Layers of Methodology

As seen above, the research question and objectives presented in Section 1.5.2 are not best considered using hypotheses, theories, meanings, critiques, or artefacts. Thus, many of the issues involved in a typical discussion of methodology require varying levels of amendment or reinterpretation to make sense when testing the utility of a framework for understanding. However, the standard categories for conceptualizing methodology remain a helpful structure for understanding the existing research landscape. The next sections of this chapter will visit these categories to place this research into its context.

Using the metaphor of the "Research Onion" introduced by Saunders, Lewis, & Thornhill (2012), research methodology can be pictured as a multi-layered onion, in which we must "peel back" the inner layers of philosophy, approach, and strategy, before we can answer the research question using the actual methods. In this chapter on research methodology, I adopt the onion metaphor, starting from the outside and working in. Section 4.3 will explain the research philosophy that underlies the research, Section 4.4 then explores the strategy used to guide the research, and finally, Section 4.5 details the actual techniques and procedures used to reach the research objectives.

4.3 RESEARCH PHILOSOPHY

Saunders et al. (2012) and Blaxter, Tight, & Hughes (2010) suggest several potential research philosophies and paradigms, gathered from various classifications. As is common, this research does not easily fit precisely into any of these philosophies, but creates a coherent hybrid of several of them. The various philosophies are outlined below, along with an explanation of why they are not a perfect fit for this research.

POSITIVISM views reality as objective and external. It assumes that reality can be known, in a value-neutral manner, by testing hypotheses using quantitative methods. The Dooyeweerdian approach being used recognizes that the positivest mode of research is often appropriate for the KINEMATIC, PHYSICAL and BIOTIC aspects, but it is not appropriate or helpful for developing or testing multi-aspectual frameworks. Although some quantitative methods are used in generating the heatmaps in Section 6.6, I am not using them to test hypotheses for truth. Rather, they serve to help visualize the areas of insight that each research area can cover.

POST-POSITIVISM retains much of the basic philosophy of positivism, except that it recognises that our ability to know reality is imperfect and often probabilistic. The acceptance of qualitative techniques means that a post-positivist philosophy is a somewhat better fit for this research than classic positivism. The notion, common to both positivist and post-positivist, that there exists a reality external to the humans who observe and analyse it, and to which we have (limited) epistemological access, fits well with a Dooyeweerdian philosophy. However, the emphasis on creating and testing hypotheses to form theories which explain observed phenomena means that post-positivism is not a good fit for testing frameworks for utility and insight.

INTERPRETIVISM obtains and analyses people's interpretations of the situation or phenomenon as its main focus. Though this thesis will demonstrate the of the use of the framework to analyse phenomena and situations, what is being tested is the philosophically based framework itself and its ability to provide insight into major unresolved questions, and not the attitudes and interpretations of the people involved. In fact, the framework assumes that individual interpretations may be limited, and seeks to find the reason why. Because of this, the research does not fit particularly well within an interpretivist epistemology.

REALISM/OBJECTIVISM is related to post-positivism. It recognizes the existence of an external and objective reality, but it also accepts interpretivism's insight that the beliefs of human participants are part of the reality being investigated. Based on the thinking of Dooyeweerd, the research philosophy of this thesis accepts the claim of a realist approach that there is an external reality to which we have some access, and emphasizes that a fully detached observer is not possible. Particularly when investigating "everyday" phenomena, recognizing the non-neutrality of the observer as part of the subject being investigated is important. The framework itself is not an objective, external reality, but a structure for helping us think. Again, because the goal is not to determine if the framework is true, this philosophy is of limited applicability.

PRAGMATISM/FUNCTIONALISM accepts whichever research methodology seems appropriate for the research goal in question. Because this research approach would require a particular *goal* in mind in order to choose the best *means* to use, this thesis does not fit easily under these research paradigms. The HUCF is intended as a widely applicable tool for insight which can be valuable when applied in any computer use situation. [1]

CRITICAL research seeks not merely to understand what is, but to "find alternatives to existing social conditions which more adequately address human desires" (Ngwenyama, 2002, p. 117). Critical research has both objectivist and subjectivist forms, referred to as "radical structuralist" and "radical humanist" respectively (Burrell & Morgan, 1979, p. 22).

RADICAL STRUCTURALIST research recognizes that there are external structures that direct human life, including research in each field. The HUCF

1 While this research does not employ a pragmatic or functionalist research philosophy, it may be worth pointing out that adherents of such research paradigms might benefit by application of Dooyeweerdian approach, as the diverse forms of normativity available within Dooyeweerd's aspects provide a solid basis for thinking about *appropriateness.* As such, it could provide guidance on which research methods might be appropriate in various research circumstances. As is, the pragmatic ontology seems to endorse an ad hoc approach to choosing appropriate research methods, which leaves it open to accusations of bias, inaccuracy or unethical research behaviour.

agrees with this. However, the HUCF is distanced from radical structuralism in two ways. First, radical structuralism tends to presuppose that existing structures are wrong and must be replaced or destroyed (Burrell & Morgan, 1979). While the framework acknowledges that existing structures may need changing, it allows for a critical exploration of the structures, including the possibility that they are normative. Second, the structures that radical structuralism presupposes can only include those which have actually occurred in the historical development of society. The framework, based on Dooyeweerd's rich ontology, also recognizes the structures of meaning and possibility by which the historical structures have come into being. A Dooyeweerdian philosophy also allows for structures that are potential rather than actual.

RADICAL HUMANIST seeks to question underlying assumptions, often with the default position that they are false or unwarranted (Burrell & Morgan, 1979). The framework is close to this approach, as it also is built on questioning assumptions, but the HUCF also gives a way of reasoning about whether or not the assumptions are, in fact, unwarranted. Rather than taking for granted that the assumptions are false, the framework notes that many underlying assumptions absolutise one aspect of meaning. Thus, the HUCF allows for assumptions that are *limited*, but not necessarily entirely wrong. Instead of discarding prevailing assumptions, the goal of the HUCF is to allow them to be situated in a wider field, demonstrating their restricted areas of applicability.

None of these approaches provides a direct fit for the needs of my research question, and so I combine several of them into a coherent hybrid. This approach to methodology is espoused by Mingers (2001) in his paper, “Combining IS Research Methods: Towards a Pluralist Methodology”, in which he argues that: “different research methods (especially from different paradigms) focus on different aspects of reality and therefore a richer understanding of a research topic will be gained by combining several methods together in a single piece of research or research program” (Mingers, 2001, p. 241).

This thesis draws heavily on the critical tradition in research insofar as it recognizes that actual computer use situations frequently are not as beneficial as they could be, and thus searches for alternatives to the status quo. Critical research assumes a notion of norms, most often concentrating on power relationships or alienating and restrictive social conditions (Myers & Klein, 2011). By thinking of normativity purely in terms of power, domination and the need for emancipation, critical approaches tend to make the unwarranted assumption that the status quo is non-normative by definition, and thus requires challenge and overriding. The Dooyeweerdian foundation used in the HUCF can go beyond these limited notion of norms, however, because the multi-aspectual nature of the framework recognizes widely diverse normativity. A richer sense of normativity can address this problem with critical approaches, by enabling an analysis of the status quo and helping us to determine which elements of the current situation are good and which parts require challenge and improvement (Basden, 2009).

The multi-aspectual normativity present in the Dooyeweerdian foundation of the HUCF assumes that norms are inherent in the nature of reality itself, and thus are not created by the functioning of human subjects. This is important, because the framework claims that proper functioning, and the emancipation from unwarranted restraints which traditional critical research aims for, can only be achieved by simultaneous realisation of all the norms.

Because the Dooyeweerdian framework assumes that the structure of multi-aspectual normativity exists and has meaning outside of the human subject, this research also takes some insight from the post-positivist research philosophy. Post-positivism stipulates that there is an objective reality which exists outside of the actions and perceptions of individual human subjects, and which is accessible to the research in at least a limited or fallible sense. Thus, this research shares some philosophical insight with the post-positivist paradigm, but not specific methodological tools, such as action research, grounded theory or deconstruction (Baskerville & Wood-Harper, 2002, p. 130).

Table 1 summarizes the three research philosophies which have the most to contribute to this research, and indicates the identified strengths and weaknesses that each have in this context. In this way, I attempt to appreciate the insights provided by the various methodologies while also being selective about which actual methods are appropriate for the research question being asked. Midgley (2000) refers to this as methodological pluralism, and Mingers (2001) calls the approach multimethod research.

4.4 RESEARCH STRATEGY

Saunders et al. (2012) suggest a number of possible research strategies, such as experiments, surveys, case studies, action research, grounded theory, ethnography, and archival research. However, each of these strategies is best suited for dealing with creating and testing hypotheses and theories, and not for assessing frameworks. In order to test a framework for insight and utility, different strategies are required.

4.4.1 *Using Examples*

In order to test the framework for fruitfulness, it is sufficient to show that it is helpful and insightful when applied to actual computer use situations (see Section 4.1). The demonstration

Research Philosophy	Strength which this research recognizes and incorporates	Weakness which this research attempts to address and overcome
Post-positivism	Recognizes the existence of an externally-valid, objective reality which is epistemologically accessible in at least a limited and imperfect way.	Does not provide a way to reason about normativity and challenge the status quo
Radical Structuralist	Recognizes the existence of social and psychological structures which shape and direct human life, and that these structures may not be fully normative.	Does not provide a way to determine which structures are non-normative and need to be challenged, and which are normative and provide needed and helpful structure for our living.
Radical Humanist	Recognizes that our understanding of both our behaviour and our social reality is heavily influenced by underlying assumptions which may themselves be incorrect and need amendment or replacement.	Tends to assume that *all* assumptions are unwarranted and should be eliminated. Often "throws the baby out with the bathwater."

Table 1: Summary of contributing research philosophies

will be particularly compelling when the computer use situation in question is complex or not well understood using other approaches to understanding. Although the use of examples could not be used to demonstrate either the philosophical validity or the universal applicability of the framework, these are not my goal. My much more modest undertaking is to show that, in at least some computer use situations, analysis using the framework is usefully insightful – that is to say, fruitful. Thus, testing the framework for utility is really the same as demonstrating the framework in action on a suitable problem, and showing it to be useful.

What makes a suitable problem? If the problem being analysed is already well understood, it would be difficult to demonstrate the value of the insight generated by the framework. A problem that is relatively straightforward and concrete is also likely to be unsuitable, as the richness of the framework itself might then be perceived as adding complexity to a situation unnecessarily. If the problem is already recognized as complex and multifaceted, then the richness of aspectuality which the framework brings can more easily be recognized as appropriate.[2] Finally, in order to demonstrate the ability of the framework to expose the interlinking relationships between the human and the computer that occur in an everyday use situation, I must choose a situation in which the problem is, in fact, *problematic* across the full spectrum of interaction and engagement. Thus, a suitable problem to test the HUCF must be a problem which is complex, which exposes the rich interplay between the computer and the human, and which is not currently well-understood.

In order to accomplish this, I'll demonstrate the use of the framework on several small examples, in Chapter 5, providing examples of how the framework can be used, and exploring

2 The Dooyeweerdian foundation of the framework might suggest that a full understanding of any situation will necessarily involve irreducible aspectual complexity, and that there is thus no such thing as a truly simple problem. However, even if we recognize that all situations involve some minimum level of absolute complexity, that does not imply that some situations are not, relatively speaking, more complex than others.

some of the limitations and difficulties that arise when using it. I'll then move to the central example of this thesis, that of computer procrastination, in Chapter 6, and demonstrate how the use of the framework can provide significant assistance in both understanding and designing against this significant difficulty that arises in typical everyday computer use. Although the testing and validation of the HUCF is the primary contribution of this thesis, furthering the understanding of computer procrastination is a valuable and important secondary contribution.

4.4.2 *Meeting the Research Objectives*

To meet the research objectives, I take the complex situation of computer procrastination and analyse it using the HUCF to determine what insight can be produced. This takes a number of different forms, which correlate to the research objectives listed in Section 1.5.2. In that section, I listed the objectives and indicated why each objective was necessary to answer the research question. Here, I indicate the strategy I'll use to achieve these objectives. Each of these requires its own methods:

objective 1: Show how use of the framework can provide insight into the problem.

methods:

This objective will be achieved by performing a detailed *HUCF Primary Analysis* of computer procrastination. This technique is explained in Section 4.5.1 and demonstrated in Section 6.5.

After this analysis, I will evaluate the results, and demonstrate that the use of the framework does indeed provide needed structure for understanding the problem and insight towards addressing it.

objective 2: Show how other research approaches the problem, and demonstrate that the understanding available is insufficient.

METHOD:

This will be accomplished by a thorough exploration of existing research in computer procrastination, analysing the coverage of each of the research areas identified. In addition to showing that the other research areas are not currently able to address the full issue of computer procrastination, the HUCF will also be used to investigate why they are not thus able, using the visualization technique of *HUCF aspectual heatmaps*. This secondary research and analysis is demonstrated in Section 6.4.

OBJECTIVE 3: Show how the framework can constructively engage other areas of research.

METHODS:

The framework does not operate in a vacuum, nor replace the insights of other approaches. Rather, it situates and contextualizes them. It is thus important to show how the framework can account for both the insights and the limitations of other areas of research.

This will be accomplished by analysing each of the existing areas' potential insight into computer procrastination using *HUCF existing research analysis*, and by using the visualization tool of the *HUCF aspectual heatmap* to intuitively grasp the differences between various research areas. These techniques are explained in Sections 4.5.2 and 4.5.3, and demonstrated in Section 6.6.

OBJECTIVE 4: Critique and improve the framework.

METHODS:

Because the framework has previously been proposed but not tested, it is to be expected that the framework is not perfect. Even if the research confirms the overall fruitfulness of the framework, there will still be parts of the framework that require clarification or amendment for maximum utility. Throughout the process of both *HUCF* *primary analysis* and *HUCF existing research analysis*, any difficulties, complexities, or holes that came up when using the framework to practically analyse a down-to-earth situation were noted, with suggestions made in Chapter 3 for possible modifications to the framework to ameliorate or eliminate these difficulties. For example, in Section 3.4 I detailed the decision process that led to the renaming of the "Engaging with Represented Content" category from the original formulation to the concept of "Engaging with Represented Meaning", as the requirement that the content be represented in some fashion in the software proved to be both onerous and unnecessary.

4.5 TECHNIQUES AND PROCEDURES

The three main research techniques involved in the research strategies identified above are *HUCF Primary Analysis, HUCF Existing Research Analysis*, and *HUCF Aspectual Heatmaps*.

4.5.1 *HUCF Primary Analysis*

HUCF Primary Analysis is the use of the framework to directly analyse a particular computer use situation. In the most direct case, this means that the computer use situation is analysed in each aspect and each functioning in the HUCF, to identify the meaning of the computer use situation in that aspect and category. The result is a matrix, 15 rows by 3 columns, realizing the rich fullness of the computer use in 45 cells. A simple example of this process is illustrated at the end of this subsection. Other examples of such analysis are shown in Chapter 5.

Once such a table is completed, insight is can be gained from this analysis in three ways:

1. The individual contents of each cell may spark fresh insights into the problem, particularly in aspects and functionings that are often overlooked.
2. The relationships between various cells of the table (either between aspects, between functionings, or between both) can be questioned and examined.
3. Overall patterns may become visible (particularly when combined with the Heatmap Visualization technique below) that weren't intuitively available.

HUCF Primary Analysis example

To illustrate the *HUCF Primary Analysis* technique, this section includes one example of the technique. Several others are included in Chapter 5. This is a simple analysis of the computer use situation of listening to streaming music over the internet service Pandora[3]. The software allows users to configure a number of "stations", and to vote songs up or down as they are played. Over time, the algorithm attempts to predict which songs you'll like based on your past preferences. A screen shot is shown in Figure 2.

Creation of the aspectual analysis table involves going through all 45 possible combinations of aspect and functioning, and determining in which ways using the application is meaningful in that aspect and functioning. For example, starting in the upper left corner with Quantitative/HCI, I consider which parts of interacting with the computer and interface are meaningful in a primarily quantitative sense, and I immediately notice that the concept of quantity arises in numerous[4] ways: the browser window is divided into a *multiple* different areas, and that the application lists a *number* of past-played songs (two, in the web version) and shows *several* configured stations on the left-hand

3 Pandora, located at http://www.pandora.com, is available primarily in North America. It is similar to a number of other streaming music services available in other countries, such as Grooveshark, Last.fm, Jango, or Spotify.
4 No pun intended.

Figure 2: Screen shot of the Pandora web application

side. Moving one column to the right, to Quantitative/EMC, when we look at our use of the application through the lens of the *content* it represents, we see that some of the "behind-the-scenes" meaningfulness of the content matter itself becomes important, such as *how many* "seed songs" we've used to customize this station to a particular style. When we move to the last column on the right, Quantitative/HLC, we consider what is quantitatively meaningful in our daily lives when living with this computer use. In this functioning, issues such as the *number* of songs we listen to throughout the day, or the *number* of genres we have configured, become apparent.

In this manner, one can go through each of the 45 cells in the HUCF Analysis table and intuitively discern what is meaningful in each aspect-functioning.

It is important to recognize that this intuitive discernment necessarily involves a certain level of subjectivity in the analysis. That is, two different people analysing the same computer use situation may come up with somewhat different HUCF analyses. That, however, is not a drawback of this technique, but rather a strength. The focus of the framework is on what is meaningful in the interaction of the human user and the computer use situation, and that meaningfulness exists in the subject-functioning of the human user, so a certain level of subjectivity in the resulting analysis is not only to be expected but welcomed.

The rest of the analysis is shown in Table 2.

4.5.2 *HUCF Existing Research Analysis*

The HUCF can also be used to help us understand how a particular research area views the human use of computers. This is valuable, because it can point out which parts of a problem will benefit from the insight available in each field of research. It can also help us to locate holes in the existing research, pointing us to areas that need additional study.

For example, in the examination of the problem of computer procrastination in Chapter 6, this technique is used to investigate the research areas of:

- Psychology of procrastination
- Human-Computer Interaction
- Technology Acceptance Model
- Non-work-related Internet Use
- Problematic Internet Use

There are varying ways to perform this analysis. If a field is small and well-defined enough to identify a small set of seminal research papers which summarize the state of the art in that field, that set of papers can be used to generate an HUCF analysis. This is done by having an aspectually-aware reader go through each of these papers, looking for key words and phrases that indicate meaning in a particular aspect and functioning. As with HUCF Primary Analysis, the result is a 15 x 3 matrix which contains words, phrases, and sentences from a

Aspects	**HCI (Human/Computer Interaction)**	**EMC (Engaging with Meaningful Content)**	**HLC (Human Living with Computers)**
QUANTITATIVE (discrete number)	*Number* of stations on screen. *Number* of recent songs displayed. *Number* of seconds remaining in the song.	*Number* of stations I have configured. *Number* of "seed songs" or "seed bands" I have selected. *Number* of times I skip a song.	*Number* of songs I listen to. *Number* of genres I listen to throughout the day.
SPATIAL	Amount of *space* dedicated to the current song, lyrics, band information, etc...	No *local* storage *space* is needed for the music.	Takes place on the *same screen* as all of my other computer-activities.
KINEMATIC (movement)	Song list *slowly scrolls* as new songs come on. Need to *move* mouse to select station, like or dislike songs.		Can choose and play music without *moving* from my chair.
PHYSICAL	The *forces* needed to operate interface (mouse clicks, keypresses, etc.). *Physical forces* acting on my speakers to produce the music.	Original sound was produced (vocal, acoustic instruments, digital instruments) and recorded (microphone, signal *voltages*) *physically*.	The *acoustic* (PHYSICAL) underlies the sensation (PSYCHIC/SENSITIVE) that occurs in my ears/brain.
BIOTIC			A sense of *flourishing* and *life* can flow from music. That is, the language of *life* is often an appropriate way to talk about the effects of music.
PSYCHIC / SENSITIVE (Perception, feelings, emotions)	I can *see* the *images*/text on the screen, and can *hear* the *audio*.	I don't just *hear* the *audio*, I *perceive* the music. The beauty, rhythm and other features of the music can stir a variety of *emotional reactions*.	Listening to music can have a profound effect on my *psychic/emotional state*.
ANALYTICAL (Distinction)	*Distinguish* between stations, artists, songs.	*Distinguish* whether or not I like a particular song (and then *vote* on it to personalize future selections). Behind the scenes, the creators of the "Pandora Internet Radio" service have *analysed* thousands of songs to *categorize* them in a variety of ways to find *similarities* between my tastes and other songs I might like.	*Distinguish* which type of music I'm "in the mood for".
FORMATIVE (Shaping, creating culture)	*Construct* a personal profile of stations on screen.	*Shape* a profile for each station of which kinds of music I want associated with that "station".	Participate in *culture* by *building* my own list of styles and sub-genres of music that I enjoy.
LINGUAL (Symbolic meaning)	Use of *words*, *symbols* to *communicate* about current station, currently playing song/artist.	Song have *lyrics* which *communicate* (often obliquely or poetically)	The music *carries* the song *lyrics* beyond just "meaningful content" and embed them in the living of our lives. *Lyrics* "stuck in your head."

Table 2: HUCF Primary Analysis of Pandora

Aspects	HCI (Human/Computer Interaction)	EMC (Engaging with Meaningful Content)	HLC (Human Living with Computers)
SOCIAL	*Social conventions* of software on the web make the user interface easy to use if you're used to other web-based applications.	The collections of musical preferences of *others* (their "stations") can be used to help predict which kinds of new music you'll like based on which songs you already like.	Has the ability for some *social-networking*-type functionality, such as *sharing* stations and song-lists with *friends*. (However, this is auxiliary to the central functionality, does not seem to be *commonly* used.)
ECONOMIC	The screen seems *optimized* for mobile devices, resulting in *wasted* white space on larger screens. Needs to *economically* include the currently playing song, a blurb about the artist, and on-screen advertising (which is how they make *money*.)	Attention is a *limited commodity*. When a song comes on that does not meet my preferred criteria for this station, I can "vote it down", *simultaneously* skipping to the next song while also informing Pandora that I don't like songs with these particular characteristics, thus influencing future music choices.	A lot of time can be *wasted* reading easily-accessible biographical information about bands/albums. The "cloud-based" nature of the application uses *significant* amounts of internet *bandwidth*.
AESTHETIC (beauty, harmony, fun)	The screen is *nicely* and *simply* laid out. The inclusion of images of the artists/albums is *pleasing*.	Discovering new *music/artists* has a strong element of "*fun*" to it.	Music is *aesthetically qualified*. The *beauty* of music has a direct effect on *aesthetic quality* of our lives.
JURIDICAL (Justice, giving what is due)	The interface needs to do *justice* to the music, to the meta-information (song title, band biography, etc…) and the listener. Because we are used to being able to rewind or replay, the omission of that feature feels *unjust*.	For *legal/copyright reasons*, they must behave enough like a radio station rather than allowing people to choose specific songs to play at specific times. This is why the ability to rewind or replay is absent and it means that there is a *limit* to how many songs can be "voted down" per hour. Voting a song up increases the statistical likelihood of it being played again, but does not allow the user to choose an exact song.	There is a sense in which we have a *cultural obligation* to "do justice" to the wide variety of musical genres by occasionally listening to music we don't like in an effort to increase the width of our musical appreciation. On one level, Pandora allows you to discover new music, but on a more decisive level, since the goal is always to find new music that's similar to what you already like, you can create a station profile that only plays music within a very narrow range of style.
ETHICAL (love, self-giving)	The interface allows very *limited* customization, and has a very *small* feature set.	The wide, wide array of music available feels *generous*.	
PISTIC (faith, trust, self-vision)	I *view myself* as controller of a large, randomly-accessed music library.		The tight control I have over the exact varieties of music on each station reinforce my *self-view* as in *control* of my environment. Simultaneously, the wide variety of genre-based stations I can configure allow me to *think of myself* as a cultured individual with widely-varied tastes.

Table 2: HUCF Primary Analysis of Pandora (cont.)

cross section of the important literature in that area. An example of this type of HUCF existing research analysis is shown in Sections 6.6.4.

If the selection of a small set of papers is impractical due to the size or scope of a research field, other possible sources for the analysis include widely-adopted introductory textbooks, data-gathering instruments such as surveys, questionnaires that are central to the field (demonstrated in Section 6.6.3) , and interviews with experts from the field. (The use of a Dooyeweerdian approach for knowledge elicitation interviews is extensively explored by Kane (2005) in her PhD thesis.)

4.5.3 *HUCF Heatmap Visualization Technique*

In order to visualize which aspects and functionings are important in a particular computer use situation or to a given research area, a heatmap-style graph (Heat Map, 2014) can be constructed from the analysis. To do this, the 15 x 3 matrix that is produced in either *HUCF Primary* Analysis or *HUCF Existing Research Analysis* can be further abstracted to produce a single quantitative value. Although the exact value which is abstracted can be context-dependent, in general the concept of meaningfulness is what is most important to capture in an aspectual analysis, as captured by the question "How central is the meaning in [this aspect and functioning] to this situation?" Then a simple rubric can be used to determine which weight to assign to each category:

Value	Meaning
0	Not at all explicit
1	Very little reference
2	Some reference
3	Plays a major role
4	Central to this area

Once we have a completed matrix filled in with values zero through four, we can convert it to a heatmap (see Fig. 5 for an example) to aid in visualization. This form of visualization can be helpful for spotting patterns in which aspects and functionings are either important or overlooked in a particular computer use situation. It is particularly helpful when comparing two or more related aspectual analyses. For example, see the comparison of multiple areas of research into computer procrastination summarized in Figure 11.

4.5.4 *Analysis as Source of Data*

It should be noted that the three techniques outlined above all rely on analysis as their source for data, rather than measurement, experiment, or other forms of empirical observation. Because the framework is a tool for analysis being tested for insight, this is appropriate. The data that the analysis provides is most often, in its raw form, a 45-cell 15x3 table of aspectual functionings, along with the insights gleaned from the relationships between these functionings. That these insights are gained from an analysis (of an existing situation or existing research) rather than empirical study is essential to the argument that these insights emerge from the framework itself, and not from surrounding ancillary activities that might be used in studying it; the source situations for these analyses is not the focus of the thesis.

4.6 SUMMARY

Section 4.4.2 gave a brief description of the method by which each research objective would be met, as summarized in Table 3.

	OBJECTIVE	METHOD
1	Show that framework provides insight	HUCF primary analysis of an appropriate example case
2	Demonstrate that existing understanding is insufficient	Literature review of appropriate existing research areas
3	Show how HUCF engages constructively with other research	HUCF existing research analysis; HUCF heatmap visualization
4	Critique and improve framework	Note practical difficulties that arise during use; suggest appropriate alterations

Table 3: Methods for meeting the research objectives

The three main techniques by which the HUCF can be applied to an existing problem are:

- *HUCF Primary Analysis*
- *HUCF Existing Research Analysis*
- *HUCF Heatmap Visualisation*

In practice, Heatmap Visualisation is almost always used in support of the first two, rather than in its own. Chapters 5 and 6 of this thesis will use these techniques to meet the research objectives, with an emphasis on the primary example case of computer procrastination.

To meet the first objective, in Chapter 5 will demonstrate HUCF Primary Analysis on a several of smaller examples and discuss the findings, before showing the in-depth study of procrastination in Chapter 6.

Chapter 6 also includes a significant literature review, presented in Section 6.4, which is analysed with *HUCF Existing Research Analysis* in Section 6.6. In this way, the second and third research objective will be demonstrated.

Finally, the meeting of the fourth objective was described in Chapter 3.

In this chapter, I have detailed the research philosophy and resulting methodology and strategies for meeting the research objectives. The results of such a methodology are not data in the traditional sense of the word, as would be common in most social or natural science research, but rather an interpreted analysis. Chapter 5 shows a number of small examples, while Chapter 6 is at the centre of the thesis, providing a "miniature PhD Thesis" in its own right that will demonstrate the use of the framework for creating insight. The results of this demonstration will then be discussed in Chapter 7 and the implications of those results in Chapter 8.

5

EXAMPLES OF THE HUCF IN ACTION

As argued in Section 4.4.1, "in order to test the framework for fruitfulness, it is sufficient to show that it is helpful and insightful when applied to actual computer use situations." This chapter makes progress towards that goal by demonstrating the use of the framework on a handful of small computer use situations. This is useful for both demonstrating the variety of situations that can be profitably analysed using the HUCF, and also providing example evidence for use in assessing the framework in the Discussion and Findings chapters. Each of the following sections briefly introduces the computer use situation being analysed, then shows the HUCF Primary Analysis matrix in table format, and concludes with a short discussion of the insights that are available because of the analysis.

5.1 MAIL-MERGE GRADEBOOK

In my teaching, I use the mail-merge feature of Microsoft Word and Excel to send my students an up-to-date snapshot of their standings in my (Excel-based) grading[1] spreadsheet several times a semester. Once configured, it's relatively little work to do, and my students often express appreciation for knowing exactly how they're doing in the course, and being able to see at a glance if they've missed any assignments. This is a somewhat complicated use of the computer because it involves use of three separate software packages: Microsoft Word, Microsoft

1 'Grades' and 'grading' are the American terms for what would generally be called 'marks' and 'marking' in England. Because the assessment being described took place in an American context, I have elected to use the American terminology in describing this case.

Excel, and Novell GroupWise, my email software. An aspectual analysis of this situation is shown in Table 4.

Discussion

A number of observations can be made on the basis of this example.

First, note that the majority of cells in Table 4 are filled in. Because all three functionings are *human* functionings, and humans are multi-aspectual beings, there is a sense in which one might expect all of the cells of the table to be filled in. However, while humans function in all aspects simultaneously, that does not imply that all aspects are of equal importance at any given time. Thus, while as a human I doubtlessly am functioning in the Kinematic/HLC category in *some* way (for example, moving between my desk and my computer while grading papers), that way may be so relatively insignificant that it is not worth mentioning in the HUCF aspectual analysis. Indeed, including it might be actively misleading as there is likely a psychological tendency to see all entries as relatively similar in importance.

The fact that the majority of cells are filled in nonetheless is an indication that each of the aspects and each of the three functionings are necessary for understanding the situation, as excluding any of them would eliminate some piece of information about the computer use that is potentially relevant. This observation will be true of the majority of the following analyses, and forms an important piece of evidence that the each of the aspects and each of the human functionings is a necessary part for understanding the whole picture of computer use.

Second, this example demonstrates that the framework is useful for analysing the use of multiple simultaneous software packages. Many other practical frameworks for understanding computer use, such as the Technology Acceptance Model (TAM), are formulated for use in analysing a single software applica-

Aspects	**HCI (Human/Computer Interaction)**	**EMC (Engaging with Meaningful Content)**	**HLC (Human Living with Computers)**
QUANTITATIVE (discrete number)	*Number* of programs to be used; *number* of keystrokes to switch between them	*Numeric* scores on tests and assignments; *number* of assignments; arithmetic to determine grade	*Number* of students; *number* of times per semester grade reports are sent
SPATIAL	*Space* on the screen for running multiple programs	"*Space*" of the grade curve	Use of email means students do not need to be in the same *place*
KINEMATIC (movement)	*Scrolling and moving* windows on screen during mail-merge process		
PHYSICAL	Keyboard *force*; monitor *photons*		
BIOTIC	*Metabolic processes* related to sitting and using a computer		The *health* of students is often related to their grades and their progress throughout the semester (perhaps through the mediating force of stress)
PSYCHIC / SENSITIVE (Perception, feelings, emotions)	*Visual communication* from computer monitor; *feel* of keyboard mouse;		Empathise with students' *feelings* (frustration, relief, worry, pride, etc.) when receiving a report on their current grade
ANALYTICAL (Distinction)	*Distinguishing* between different programs; *determining* how to operate the mail merge feature	*Distinguishing* between letter grades earned; determining how assignments should be included in the grade calculation	*Distinguishing*, for students, how well they'd have to do for rest of semester to receive their goal grade
FORMATIVE (Shaping, creating culture)	Interface is composed entirely of techno-cultural *artefacts*; windows *built* of components, which are *built* on lower level of abstraction yet, etc.	(Assessed) content of the course *formed* by instructor; final grade reflects that *shaping* process	*Creating* a class *culture* of work, submitting assignments, assessment, and feedback
LINGUAL (Symbolic meaning)	The icons in the menu bar *symbolise* actions that can be taken	*Understanding and communicating* how final grade is determined	*Communicating* to students
SOCIAL	Strong *social conventions* built into the use of the user interface	Taking into account the *average class performance* when determining where break-off points will be between letter grades	Providing regular, up-to-date feedback is a form of *respecting* students; without this kind of feedback, the grading process can make students feel helpless, or lost-in-the-dark, regarding their grade
ECONOMIC	The mail-merge feature is not as commonly used as many other features; hasn't been as thoroughly *optimized*; cumbersome to navigate, many extra steps and time that *wouldn't be necessary* with a better design		*Saves* the instructor a lot of time over doing it manually; (doing it manually would be *too much work*, so it just wouldn't be done); use of email is *fast* and *uses no paper*

Table 4: HUCF Primary Analysis of Grading Report

Aspects	HCI (Human/Computer Interaction)	EMC (Engaging with Meaningful Content)	HLC (Human Living with Computers)
AESTHETIC (beauty, harmony, fun)	Process lacks the *smooth, harmonious* functioning that is typical of many other uses of Microsoft Office products.		Provides a more *harmonious* semester experience for students, without a nasty *surprise* at the end, in which the student suddenly discovers that they didn't know the material as well as they thought they did.
JURIDICAL (Justice, giving what is due)	Use of three separate programs (Microsoft Word, Microsoft Excel, and GroupWise mail client); *interface* must give each of these separate functions its *due*; interface between Microsoft products and email software relies on *standards*, which are juridical in nature	Grading must be "*fair*" to each student; can't show *favouritism*; must also *give due* to the content that the course covers, putting *appropriate* weight on the *more important* course-related topics	Students *deserve* to know how their grade is calculated
ETHICAL (love, self-giving)		Feedback to students on their class performance ought to *go beyond* the numbers and provide qualitative, *personal* appraisal and suggestions for improvement; however, the mass-produced, numerical nature of this grade report process inhibits that direction of *self-giving* on instructor's part	The entire process is not a strictly necessary effort on instructor's part; by going "*above and beyond*" the base requirements for teaching a course, instructor demonstrates *love/caring* for students
PISTIC (faith, trust, self-vision)		The numeric and automated nature of this part of teaching administration *tempts* instructor to *see self* as an administrator of a data-oriented process, that job is to shovel pieces of data into the brains of students. Or that their *role* is as a behaviourist manipulator, with the sending of frequent grade reports helping to psychologically manipulate students into working harder. Alternately, it could encourage them to *identify* as a caring "shepherd-style" educator, working with students to let them know how they're doing so that they can see where they need to improve.	The highly numeric nature of grading may encourage both instructor and students to *view students* as "just a number", throwing the *role/vision* of the student into one where they work for a grade rather than for the knowledge and understanding the grade theoretically represents.

Table 4: HUCF Primary Analysis of Grading Report (cont.)

tion being used at a time. Because modern operating systems allow multiple applications to run simultaneously, and regular switching between applications is common, this is an important benefit of the HUCF. It will be particularly useful in the main case study of computer procrastination in this thesis.

Another observation, which was intuitively grasped before the analysis but is seen more directly in the ANALYTIC through the JURIDICAL aspects of HCI functioning in Table 4, is that the mail merge process is not very well optimised; it is much more cumbersome to operate than most uses of commercial word-processing and spreadsheet software. We can see that this cumbersomeness, which is most obvious in the AESTHETIC aspect of HCI, comes from the peripheral and uncommon nature of the task, which involves the interworking of multiple different software applications in ways that were not necessarily directly envisioned in the early design of this software.

Fourth, the EMC functioning in the FORMATIVE, ETHICAL, and JURIDICAL aspects demonstrates the importance of designing and executing an appropriate grading system for meeting the overall course goals. This observation does not stand on its own, but is directly related to the computerized, quantitative nature of the grading and reporting system I have implemented, and gives me occasion to question if the way I have set things up is optimal for the learning of my students. To the extent that education as a whole is characterized by the ANALYTICAL aspect, the entire purpose of assessing (grading) assignments needs to serve this purpose. I want to enable students to quickly "know how they are doing", without overly encouraging a culture in which "achieving the desired grade" is a more central focus than actually learning for the sake of knowing the material. Frequent and detailed grade reports may work against this goal.

This fourth observation is closely related to the fifth, which is that the use of the framework makes an excellent catalyst for careful introspection and change. In this case, simply performing the HUCF Primary Analysis called attention to aspects of my own life and work that I had not previously considered very thoroughly, and provided not only an opportunity but also a tool to consider these. In this particular case, the ETHICAL and PISTIC aspects of the EMC and HLC functionings encouraged me to renew my internal commitment to being a certain type of educator, and pointed out to me ways in which I could improve in that ambition. This encouragement and opportunity for self-improvement was an unforeseen benefit of using the HUCF. As a result, I have altered the way in which I use this mail-merge process, using the occasion of sending the mass grade report to also look for individual students who would benefit from personal attention, and sending them a private note as well.

5.2 COLOUR TEMPERATURE SOFTWARE

I use an application, F.Lux, to automatically alter the the "colour temperature" of my computer monitor throughout the day. Typical computer monitors are designed to match the colour temperature of daylight. (Colour temperature is a physical property of light most noticeable as the levels of red and blue.) Because daylight has a much higher colour temperature than the warmer, redder colour of indoor lighting, computer monitors can appear washed out, or even blinding, when used at night. As the sun sets and dusk fades to night, the F.Lux software automatically and gradually lowers the colour temperature to warmer, dimmer tones which make for a more soothing match to the ambient lighting provided by incandescent or compact florescent lighting.

The software runs in the background, requiring minimal configuration and virtually no maintenance once running. The analysis below, then, refers to the experience of using a computer with this software installed and running inconspicuously, and not to the experience of installing/configuring the software.

Aspects	**HCI (Human/Computer Interaction)**	**EMC (Engaging with Meaningful Content)**	**HLC (Human Living with Computers)**
QUANTITATIVE (discrete number)		*Number* of minutes before/after sunrise/sunset; temperature in degrees	
SPATIAL	Amount of screen *space* that it takes (very little — one small icon in "tray")		An attempt to integrate my indoor work *space* with the larger context of my environment
KINEMATIC (movement)		*Movement* of sun in sky is internally modelled	Actual change in colour is too gradual to be seen as *movement*
PHYSICAL	Alters the *physics* (luminescence) of the user interface itself	Matching the monitor to the *colour temperature* of various types of illumination used throughout the day.	
BIOTIC	Although more fully expressed in the sensitive/psychic aspect, the software addresses my *biotic/organic* response to the interface.		The software attempts to address one of the unintended *biotic* consequences of increased (late-night) computer use, altered sleep patterns.
PSYCHIC / SENSITIVE (Perception, feelings, emotions)	This is the heart of the functioning for this application. Once the program is running in the background, there is almost no interface, except for the *notice* that I take of the gradually changing colour temperature.		This is the central target for the software — having the colour range of the monitor match our *sensitive* functioning more appropriately.
ANALYTICAL (Distinction)	At very low colour temperatures, images which were designed for higher colour temperatures can become dull and low-contrast, resulting in greater difficulty *differentiating* parts of the interface.		
FORMATIVE (Shaping, creating culture)			Attempts to assist me in *shaping* my own psychic functioning (i.e., to be sleepy and ready for bed at a time of my more conscious choosing.)
LINGUAL (Symbolic meaning)	Very little *lingual* functioning once the program is running in the background.	My senses *interpret* various colour ranges: "Daylight — time to be awake" or "Night-time — time to get ready for bed".	
SOCIAL			
ECONOMIC	Very *economical* use of screen space.		Potentially *saves* energy (a small amount) by lowering the brightness of my monitor in low-light conditions.
AESTHETIC (beauty, harmony, fun)	Some images, designed for viewing under daylight conditions, don't *look as good* under dimmer, warmer colour settings.		Overall, screen *looks nicer* when the colour temperature matches the ambient environment.

Table 5: HUCF Primary Analysis of F.Lux Software

Aspects	HCI (Human/Computer Interaction)	EMC (Engaging with Meaningful Content)	HLC (Human Living with Computers)
JURIDICAL (Justice, giving what is due)			
ETHICAL (love, self-giving)			Accompanying documentation seems *genuine in effort* to improve people's lives (in small ways) by making (small-but-measurable) changes in their computing environment.
PISTIC (faith, trust, self-vision)			Reminds me that as a (late-night) computer user, I have *lost touch* with the cues from my larger environment. Encourages me to *view myself* as a full human, by *integrating* the sensory/psychic experience of my "computing life" with the larger context in which I live.

Table 5: HUCF Primary Analysis of F.Lux Software (cont.)

Discussion

This application is an interesting border case for exploring the uniqueness of the EMC category, because it is difficult to clarify what, exactly, the content of this program really is, at least as differentiated from the interface (HCI) on the one hand, or the lived experience of that interface (HLC) on the other hand. In many software products, the content itself is centred around a relatively limited number of aspects. For example, CAD software is heavily oriented towards the SPATIAL aspect, and word processing software is centred on the LINGUAL aspect. While the *content* of the software may be legitimately limited in its aspectual range, *human engagement* with that software, which is what the EMC functioning is about, will generally be more broadly multi-aspectual, because in the Dooyeweerdian scheme, humans are multi aspectual beings. However, as seen in the discussion in Section 5.1, not all human aspectual functioning is of enough relevance to be worth mentioning. This is particularly the case with utility software like F.Lux, which is not primarily *interactive* software, and thus doesn't have as much human engaging with the content at all. As a result, most human engagement with the content is limited to the earlier aspects.

The analysis of using the *F.Lux* software, shown in Table 5, also shows the ability of the HUCF to serve an *evaluative* function, in which the analysis delves into how well a given software product lends itself to normative human use. In this particular case, most aspects are either done well or operate in the background, with the result that the modest goals of the software are effectively met. In particular, the PISTIC aspect of HLC functioning demonstrates the power of seemingly small changes to play an important role in improving our living with computer technology. Some research suggests that our brain interprets the brighter colours of a typical computer monitor as daylight, and thus computer use in the evening can contribute to insomnia (Higuchi, 2009, p. 76). Evening computer use with a brightly lit monitor provides false cues to the body, which then doesn't get sleepy as early in the evening as it otherwise would.

The analysis also is a good example of how frequently overlooked aspects, such as the BIOTIC or LINGUAL, can play an important role in the success of a computer application. In this way, we can see how the goals of an application can be met through effective functioning in every aspect.

5.3 BOOKING A TRAIN TICKET ONLINE

For this a third example, the use of the UK National Rail website is analysed. This is a large web application for finding routes and purchasing tickets on the British passenger rail system. In this case, I was purchasing train tickets for a family weekend getaway, and wanted to find a route option that was inexpensive, convenient, and scenic. Web application user experience testing is an important and growing field (Garrett, 2010), and this analysis demonstrates the utility of the framework to contribute insight in such a situation.

Discussion

From the analysis, we can see that an everyday event such as planning a trip by rail and purchasing the tickets is aspectually rich in HLC functioning, and that because of this, that richness is reflected in the engagement with the content of the supporting application (EMC) and, to a lesser extent, in the interface itself (HCI.)

This application is also interesting because it helps point out quite clearly a common pattern in the relationship between the EMC and the HLC categories of functioning, which is that EMC functioning is often an abstract analogue for substantially similar HLC functioning. For example, in the KINEMATIC aspect,

Aspects	HCI (Human/Computer Interaction)	EMC (Engaging with Meaningful Content)	HLC (Human Living with Computers)
QUANTITATIVE	*Number* of routes it will show at a time	*Number* of changes a route would involve	Number of hours/minutes journey takes
SPATIAL	*Space* on screen for various search options — collapsible search sections is nice	*Geographic routing* to get me from A to B (in this case, Stockport to Conwy)	Actually want to go (*move*) from A to B
KINEMATIC (movement)	Quite a bit of mouse *movement* needed to navigate through search options	Trains *move* at a certain speed between stations, etc.	Train will *transport* me on the travel day
PHYSICAL	Typical HCI physical traits: energy/force to move mouse, keyboard, photons from screen, etc.	*Physics* of train travel – capacity of rails, switching, fuel, etc. – is all assumed in the construction of the timetables.	Want to not only get there, but to do so in *fuel-efficient* (environmentally sustainable) way.
BIOTIC		The notion of "*leg* room" in the option of a first class ticket	
PSYCHIC / SENSITIVE	*Perceive/sense* the interface		I *enjoy* train travel, as it's more *relaxing* than driving
ANALYTICAL (Distinction)	Need to *distinguish* where to enter the various components of my search; (passenger info, railcards, flexibility of travel time, etc.)	Need to *determine* if my planned trip fits in their categories (When does "off-peak" travel begin? How much time will I have to make transfers, etc.)	Need to *determine* what a suitable travel schedule would be, and *weigh* it (economically, aesthetically) against the cheapest tickets
FORMATIVE (Shaping, creating culture)	*Building* up a search, and search *strategy*	The *itinerary generated*	*Shaping* my holiday *plans*
LINGUAL (Symbolic meaning)	*Symbolically communicates* the information	Abbreviations for rail stations	
SOCIAL	Design highlights the *most popular* options		Making holiday plans to spend time with my *family*
ECONOMIC	*Use* of screen space, bandwidth is *constrained*	*Trade-off* between not spending *too much time* and not spending *too much money*. Can choose to only show *fastest* routes, or show *slower* ones if they're *cheaper*	*Budget* and *time limits* need to be respected
AESTHETIC (beauty, harmony, fun)	Page is *nicely* laid out and mildly *aesthetically pleasing*	Taking the train is *fun*, particularly for the kids; some routes are more *picturesque* than others	The point of the holiday is to have *fun* together
JURIDICAL (Justice, giving what is due)		Various *government* and private *organizations* represented by the rail network each need to have their *due*. Different train *companies* have different specials and *rules*.	Want to meet the (competing) *priorities* of *different* family members in terms of travel times, etc.
ETHICAL (love, self-giving)		It does a pretty good job of *getting* me the *best* price and times.	*Want* to *give* my kids a *special*, memorable experience
PISTIC (faith, trust, self-vision)		I *trust* that it is showing me the best option.	We *trust* that the timetables listed will be adhered to.

Table 6: HUCF Primary Analysis of Buying a Train Ticket

the EMC functioning is concerned with the fact that trains, of course, move, but this primarily in the abstract; the movement from station to station is assumed in the construction of the timetables and route construction. The same concern is present in the HLC category, except that here it's not the abstract movement of the train that is in focus, but the practical, everyday desire to actually travel. A similar dynamic is present in the FORMATIVE aspect, in which the EMC category is concerned with the travel itinerary in the abstract, while the HLC considers the implications for this itinerary for the actual experience of the holiday itself.

Not all aspects will have this abstract/concrete relationship between EMC and HLC. In the AESTHETIC aspect, for example, the EMC functioning concerns the fun and adventure of train travel itself, along with the beauty of certain scenery, while in the HLC functioning, the rail trip is only one piece within a larger context of a weekend holiday. In this case, then, the EMC functioning focuses on matters that are more concrete and specific, while the subject matter for the HLC seems more distant and abstract.

5.4 WORKING OUT ON A COMPUTER-CONTROLLED EXERCISE MACHINE

For my final small example of analysis, I've chosen an *embedded* computer application context, in which the computer being used is a special-purpose device rather than a general-purpose machine. In this case, the analysis is on the use of a stair-climber exercise machine with a computerized control interface, which allows the user to select a particular workout program and intensity level, and then provides a number of statistics and measurements relating to the exercise session. Note that while this analysis is most specifically about the computerized control system, and interaction with it, this is not entirely separable from use of the exercise machine itself.

Aspects	**HCI (Human/Computer Interaction)**	**EMC (Engaging with Meaningful Content)**	**HLC (Human Living with Computers)**
QUANTITATIVE (discrete number)	*Number* of different measurements that can be displayed; *number* of buttons; *number* of pixels in display (which is not enough, as seen in juridical and aesthetic aspects)	*Number* of different measurements of exercise intensity/duration.	*Number* of calories burned, heart rate, stories climbed, etc.; *number* of different exercise programs to choose from; *number* of steps I take; *number* of times I exercise.
SPATIAL	*Space* on the control panel	Calculated *equivalent distance* that I've travelled; *distance* yet to go.	Machine takes up a lot of *space* in exercise room
KINEMATIC (movement)	Progress bar *moves* across display as workout progresses; the focus "*moves*" among different measurements using the "scan" feature.	Measured and reported body *movement*	Significant bodily *movement*, yet staying stationary as well: "*Running* to stand still."
PHYSICAL	*Light* Emitting Diodes for display; *force* needed to push buttons	Calculates *calories* (*energy expenditure*) used by body during workout; monitors heart rate *pumping* blood/*oxygen* to muscles	Significant expenditure of *physical energy/effort*
BIOTIC		Measures basic *life processes*, heart rate in particular; adjusts workout level for optimal *biotic* benefit.	*Body* responds *biotically* to increased exercise levels; *health* improves
PSYCHIC / SENSITIVE (Perception, feelings, emotions)	I *perceive visually* the information, along with *audio* cues to indicate a change of pace is coming.	"how I *feel*" is not directly represented in the content, but can be partially inferred from the level of *exertion*.	How I *feel* while exercising (tired, sweaty, invigorated, sore muscles, etc.) and how I *feel* afterwards (energized, clear-headed)
ANALYTICAL (Distinction)	Interface *distinguishes* which measurement I'm currently seeing.	*Distinguishes* between build-up and recovery phase of workout	*Distinguishing* whether or not I've exercised "*enough*".
FORMATIVE (Shaping, creating culture)	Graphical display shows the *structure* of the current workout.	I can *build up* various workouts by adjusting the intensity over time.	I *shape* the *habits* of my life to include regular exercise.
LINGUAL (Symbolic meaning)	The controller uses *words and symbols* to convey meaning to me about my exercise stats.	Heart *rate*; calories burned	I occasionally *read* or *listen* to *books* on tape while exercising. (The automated nature of the control enables this, as I don't need to constantly adjust settings.)
SOCIAL	My understanding of the symbols on the user interface is *socially constructed* (heart-shape indicates pulse rate, etc.)		While there are *other people* in the same workout room at the gym, using the stair climber is essentially a solitary activity; may compare my performance on the machine to *other* (anonymous) "standard" *users* at which the various levels are calibrated.

Table 7: HUCF Primary Analysis of Exercising on a Stair Climbing Machine

Aspects	HCI (Human/Computer Interaction)	EMC (Engaging with Meaningful Content)	HLC (Human Living with Computers)
ECONOMIC	Very *limited* "screen space", only one measurement can be shown at a time	Goal is to make *efficient* use of my exercise time by tailoring my workout to my fitness level.	I want to make *efficient* use of my time by not having to *wait* for a machine, being able to program it *quickly* to my particular workout, and get *quick* feedback on the level of exercise I'm *achieving*.
AESTHETIC (beauty, harmony, fun)	The display is not very *pretty* or *attractive*.	The information provided can have an aspect of "*fun*" to it, in terms of the *satisfaction* of working out hard, and having that quantified.	Because of its solitary, stationary nature, the exercise is overall *boring*. (Particularly compared to running outdoors enjoying *beautiful* scenery with a group of fellow exercisers, or perhaps a dog.)
JURIDICAL (Justice, giving what is due)	Gives *due* to the user by allowing quick access to meaningful measurements of exercise exertion	An *accurate* calculation of calories burned (which is difficult to achieve, as metabolisms vary) is a crucial part of JURIDICAL for EMC.	The gym specifies a 30 minute time *limit* if others are waiting for the equipment; the built-in clock helps me to achieve this. The "*promise*" of better health/fitness by using this equipment is implicit.
ETHICAL (love, self-giving)	Some exercise units have a more *generous* interface than others. This particular stair-climber feels quite *measly*. (For example, it is unable to show my stair-climbing rate and my pulse rate simultaneously.)	The content, a quantitative and qualitative characterization of my workout intensity, seeks to *help* me do what's best for me, by providing a wide variety of ways to characterize my workout.	*Enables* me to be at full health
PISTIC (faith, trust, self-vision)	I *view myself* as someone who can control how difficult my tasks are.	I *view myself* as someone who is interested in burning calories, attaining a high heart rate, climbing a number of stories of steps, etc.	I am someone *committed* to fitness, improving my health, and being mentally alert.

Table 7: HUCF Primary Analysis of Exercising on a Stair Climbing Machine (cont.)

This application, analysed in Table 7, demonstrates the ability of the framework to provide insight into the use of embedded computer systems. As such systems make up the majority of computers in use, it is worthwhile to demonstrate that the framework is also useful for analysing these computer use situations.

Unsurprisingly, the HCI functioning in a situation like this is much more constrained than the flexible interfaces possible in a traditional personal computer. For example, because the QUANTITATIVE number of measured exercise statistics is quite small, it is relatively straightforward to ANALYTICALLY distinguish which measurement is being expressed by the interface, by having a set of LED lights labelled with the various measurements possible, one of which is lit up at a time. This modest range of outputs is further reflected in the ECONOMIC and ETHICAL aspects of HCI functioning.

Because the interface only needs to provide interaction with one particular set of content (in this case, the simulated climbing of stairs), the extra complexity required in the interface to support more flexibility could easily actually get in the way, resulting in a more difficult-to-use machine and a less harmonious exercise experience.

Also worth noting in this analysis is that the EMC category takes on nearly as much richness of meaning in a very constrained, embedded situation as it does in a more expansive, general-purpose-computer situation; only the SOCIAL has no direct meaning when engaging with the content of the system.

This analysis also demonstrates one of the major kinds of relationship between the human functionings discussed in Section 3.7, that in which HLC leads. Because the most central contribution to human flourishing occurs in HLC, one way to evaluate normativity, and to look for areas for improvement, is to examine the HLC functioning in each aspect, and ask if there are improvements that could be made to the HCI or EMC functioning in that aspect to better support the HLC functioning. For example, in the case of the exercise machine, it might be possible to better support the the FORMATIVE/HLC functioning of building habits with judicious additions to the content of the program, so that the building of a daily exercise habit became part of the content of the interface itself, providing extra encouragement and psychological incentive for the user to keep it up. Likewise, the ANALYTICAL/HLC need to determine how much exercise is enough could be assisted by content (and that by interface functioning) to enable the user to track their exercise and fitness goals over time, with intelligent recommendations for exercise duration built in.

5.5 SUMMARY

This chapter has demonstrated the use of the HUCF on four smaller example computer use situations, covering a wide spectrum of computer roles. This has demonstrated a number of important features of the HUCF.

First, we can see that the HUCF is widely applicable. In the mail merge example, it was used to analyse a complex, three-program use of an obscure and sophisticated feature of office software, in the F.Lux case, it was used with equal facility on a simple non-interactive background utility. An embedded application was analysed in the exercise machine example, and an online web app was profiled in the example of the rail ticket website. In addition to the analyses in this chapter, a streaming music service was analysed in Section 4.5.1. From all of these, the versatility of the HUCF in addressing the everyday meaningfulness of a wide variety of computer use situations is demonstrated.

Second, it can be seen from these examples that the framework is relatively easy to use, in that it is oriented to everyday thinking and thus no special expertise is required to perform such an analysis. Instead, what is required is a sensitivity to the everyday meaningfulness of the computer use. This is, perhaps, an intuition that is more easily cultivated in the actual user than in an outside expert.

Third, it is worth pointing out again that in these fairly simple examples, and also in the example of the Pandora internet radio service in Section 4.5.1, the majority of cells are filled in. This stems from the fact that all three functionings are *human* functionings, and that humans are intrinsically multi-aspectual. If a user is interacting with content at all, they're doing it with meaning in all 15 of the aspects. The only reason some of the cells remain empty is because the aspectual functioning in some aspects may be so much "in the background" that it is more accurate to simply omit mentioning that functioning at all.

Fourth, we can see that both the aspects and the three human functionings are necessary for fully understanding computer use. This is demonstrable because omitting any of the cells in any of the tables would result in losing sight of some part, however small, of the total computer use situation. (Of course, any deeper analysis may certainly limit its scope to a subset of the relevant aspects and functionings; however, at the outset the full range of human meaning in interacting with the computer must be available so that wise decisions can be made about which particular aspects of the situation to concentrate on.)

Fifth, we can see repeated examples of *normativity* in these analyses. Whether it be a utility that helps the computer more closely mimic the circadian clock of nature, a train time table that helps me conserve fossil fuels expended in my travel, an exercise machine that has a skimpy display area, or a grading system that puts blocks in my way of treating my students with individuality and dignity, all of these examples show how use of the computer – interface, content, and lifestyle – is inescapably bound up with notions of what is the right thing to do and the right way to do it.

Sixth, the framework can help us appreciate and contextualise insight from a variety of other sources. For example, in the

F.Lux analysis (Section 5.2), the scientific research into the impact of computer monitor settings on human circadian rhythms (BIOTIC/HLC) can be integrated with insight about the level of natural daylight at any given time an location on earth (KINEMATIC/EMC) or graphic design insight into beauty and colour (AESTHETIC/HCI). Likewise, in the analysis of the train ticket website (Section 5.3), insights from the HCI community about how users distinguish information on-screen (ANALYTICAL/HCI) can be utilised at the same time as insight from the TAM community into what kinds of applications users find most useful (ANALYTICAL/HLC, SOCIAL/HLC) or the constraints faced by the rail authority in establishing the timetables (PHYSICAL/EMC).

Conclusion

One of the main purposes of this chapter is to provide data to meet Objective 1 (Section 1.5.2), showing that the framework provides insight. A number of these will be referred to when enumerating the results about the framework in Chapter 7. However, these examples were all for relatively simple, straightforward situations, in which there was no particular and obvious *problem* needing to be addressed. To properly assess the framework against the claims it makes for insight, a complex and problematic computer use situation seeds to be investigated. That is the focus of the next chapter.

6 PROCRASTINATION

6.1 INTRODUCTION

6.1.1 *Vignette*

> *It's 9:30pm. The kids are finally in bed, you've brewed a pot of tea, and are settling in at your desk to get tomorrow's grading done before reviewing that grant application for your colleague, like you promised. You grade a couple of electronically-submitted problem sets, but something one of the students has written sparks a question about a side-issue in a class lecture you've prepared for next week. You quickly Google it to refresh yourself on the topic. As long as you've got your web browser open, it'll take just a second to check your Facebook account to see if your buddy from the football league has posted those pictures yet.*
>
> ...
>
> *An hour later, you return to grading.*
>
> *Despite your sincere efforts to work hard on your intended task, and realizing that you'll surely regret this poor use of time later, you constantly find yourself on off-task websites and applications when using the computer.*

6.1.2 *The Problem of Procrastination*

There seems to be something about computer technology and internet connectivity that distracts us, that tempts us towards computer procrastination. This is borne out by personal experience and by anecdotal evidence. As the computer is a tool widely perceived to enhance our productivity in many areas of life, this is remarkable. Unfortunately, there has been very little research into this phenomenon, the only study being on older one by Lavoie & Pychyl (2001). Non-computer procrastination has been studied in the area of psychology, but everyday experience tells us there is something about the computer that makes procrastination easier.

This naturally leads us to wonder, what it is about the computer that tempts us towards procrastination? In order to answer this question, however, two related questions must be addressed:

1. Why has there been so little research into computer procrastination?
2. How (on what basis) should it be studied?

Current research fields related to this problem can provide clues and insight, but are ultimately insufficient, because they often focus narrowly on a small part of the issue, and thus lack the ability to address it as a larger issue within the context of everyday life.

6.1.3 *This Chapter as Mini-thesis*

As alluded to in Section 1.6, this chapter will take the form of a complete thesis in miniature; it will be a self-contained study of the problem of computer procrastination, including its own literature review, methodology, implementation, results, and findings, all using the Human Use of Computers Framework. This is an appropriate approach to take because part of the claim being tested is that the HUCF helps to produce useful insight when applied to large and complex problems. PhD research is carried out under the guidance of a chosen theoretical framework, and thus a PhD thesis, as a well-known format for engaging with large and complex problems, makes an ideal vehicle for showing the utility of a framework. In this case, I conduct research in which the HUCF is chosen as the framework. By separating this test of the framework from the discussion of the test, the trajectory of the overall thesis is kept cleaner. As discussed in Section 4.4.1, computer procrastination is a suitably rich problem for meeting the research objectives of this thesis, and in particular, the first objective, "*show how use of the framework can provide insight into the problem.*"

In this way, I am continuing with the analogy of the framework as being like a vehicle, with testing the framework being like test-driving a new car. This chapter functions primarily as a test-drive of the Human Use of Computers Framework. Secondarily it is a profitable research exercise on its own, in the same way that a thorough test-drive of a vehicle serves primarily to find out about the vehicle, but may also accomplish a needed transportation task.

In this chapter, Section 6.2 defines, in detail, the nature of the phenomenon in question, and provides informal evidence that it is an interesting enough problem to be worth further academic investigation. Section 6.3 will describe the research methods that will be used for this "mini-thesis" chapter, and Section 6.4 contains a complete literature review of the academic areas which have, or should have, significant insight to contribute to this issue. The research implementation, made up of two types of HUCF analysis, is given in Sections 6.5 (the HUCF primary analysis of procrastination) and 6.6 (the HUCF existing research analysis). Finally, Section 6.7 details some of the results about procrastination that arise from this analysis.

6.2 THE PHENOMENON OF COMPUTER PROCRASTINATION

6.2.1 *Definition of Procrastination*

The word *procrastination* gets used in a number of different ways, and so it is important to define which form of procrastination is being investigated. In particular, this chapter assumes that procrastination "ought to always be avoided"; those cases which procrastination is judged to not be a problem are outside the interest of this research. The following summary of definitions will demonstrate that, while this assumption is not universally held by researchers investigating procrastination, it is held broadly enough to be commensurate with other usages of the word.

The Oxford English Dictionary defines procrastination as "the action or habit of postponing or putting something off; delay, dilatoriness. Often with the sense of deferring though indecision, when early action would have been preferable" (Procrastination, 2012). However, researchers into the phenomenon have had a remarkably difficult time agreeing on a precise definition to use, and what it means that *early action would have been preferable*. Thus the dictionary definition is too broad, allowing many activities to be classified as procrastination that aren't problematic, and thus aren't of interest in the current study. In order to study the phenomenon of procrastination, a more precise definition is needed.

DEFINITION BY BEHAVIOUR Researchers involved in measuring procrastination often prefer to focus only on simple behaviour without needing to consider cognitive judgements about the efficacy of that behaviour. For example, Lay's (1986) General Procrastination Scale (GPS) measures only the frequency of delay on intended tasks, without asking the respondent to judge the potential outcome of such delay. Lay et al. (1998) defined procrastination as "the tendency to put off that which is necessary to reach some goal" (p. 189). A second procrastination scale, the Adult Inventory of Procrastination (AIP) by Ferrari, Johnson, & McCown (1995) measures punctuality and habitually putting off until the deadline, but includes no items about the consequences of this, or the procrastinator's expected results.

DEFINITION BY CONSEQUENCE In order to research *solutions* to the procrastination *problem*, we must be confident that it really *is* a problem. Many examples of delay, and even habitual delay, don't seem to have negative consequences, and thus don't require a solution. Yet there is strong intuition among researchers that something about procrastination is indeed problematic. One way to address this tension is to define procrastination more narrowly so that it is problematic by definition. Ferrari (1992) does this when he defines procrastination as "the purposive delay in beginning or completing a task to the point of experiencing subjective discomfort" (p. 98).

DEFINITION BY EXPECTED OUTCOME Even more restrictive than this, many researchers suggest that in order to qualify as procrastination, a behaviour must be irrational. Silver & Sabini (1981) conclude that "when 'putting off' is rational it isn't procrastination" (p. 208), and suggest that for the procrastinator, "this irrationality is caused by recognizing or [imagining] what [they] ought to be doing" (p 218). This notion of *ought to be doing* is a rich one, and recent investigations into the definition of procrastination have explored what form this *ought* takes, often in terms of the expected outcome of the delay. Procrastination occurs when the procrastinator recognizes (or at least ought to recognize) that the benefits of prompt action outweigh the benefits of delay, but delay nonetheless (Gjelsvik, 2010). Along these lines, Steel (2007) defines procrastination as "to voluntarily delay an intended course of action despite expecting to be worse off for the delay" (p. 66), and Andreou (2007) suggests that we consider only "cases of delaying in which one leaves too late or puts off indefinitely what one should – relative to one's ends and information – have done sooner" (p. 183).

Each of these definitions requires some notion of expected result, but does not specify what form that expectation takes. The procrastinator may not *consciously* be aware of expecting to be worse off for the delay. In fact, they may be rationalizing the delay by presenting excuses to themselves, such as "I'm feeling tired right now, I'm sure I'll feel more energetic later." However, at a deeper level, they may realize, or ought to realize, that this belief is irrational.

WORKING DEFINITION We thus have a phenomenon, procrastination, which is ill-defined in its everyday sense of use. To arrive at a suitable definition for formal study and analysis, the everyday definition must be narrowed to include only delay which has negative consequences of some sort. The subjectively negative *discomfort* that Ferrari (1992) posits as part of his definition achieves this, but does not help judge whether or not an activity is procrastination ahead of time. The experienced discomfort may not happen until the consequences for the delay catch up with the procrastinator.

In order to distinguish whether or not a delay is procrastination before the delay occurs, we appeal to the best judgement of the subject. Based on Steel (2007, p. 66), this chapter defines procrastination as "*to voluntarily delay an intended course of action despite expecting to be worse off for the delay*."

It is worth noting that under this definition, procrastination is always to be avoided. That is, even though expectations may be incorrect and the procrastinator will actually end up being better off for the delay, it would still be irrational for someone to decide to go against their best judgement of the situation in the hopes that their judgement would be incorrect.

EXPECTATIONS VERSUS ACTUAL RESULTS Also note that this definition relies solely on expected outcome, regardless of the actual outcome. This does not dispute that procrastination can, serendipitously, result in net benefit to the procrastinator; this would still qualify as procrastination, as the expectation was to be worse off. It is also possible that someone delaying with the expectation that they'll benefit from doing so could be wrong and might actually suffer from the delay. This does not qualify as procrastination by the definition adopted.

While all procrastination involves delay of some sort, not all delay of intended action qualifies as procrastination. Using the categories of expected outcome and actual outcome, we can perform an analysis of 4 possible kinds of delay along these two axes. These are summarized in Table 8.

	Expect to be worse off	*Expect to be better off*
Actually are worse off	Typical procrastination	Problem is poor prediction rather than procrastination
Actually are better off	Serendipitous, but still irrational, and still procrastination	Wise, efficacious delay; not procrastination

Table 8: Possible delay types in terms of expected and actual results

There are many examples of delay that are called procrastination in the everyday sense of the word, which do not meet the stricter definition used above. However, these uses of the word, which fall into the right hand column of Table 8, are not the subject of this research, and for the remainder of this chapter, the more restrictive definition of procrastination given above will be assumed.

6.2.2 *Definition of Computer-specific Procrastination*

The subject of this chapter is not merely procrastination, but computer-specific procrastination. Unfortunately, extant literature contains no definition of computer procrastination, nor even any substantial discussion of its characteristics, and what differentiates it from ordinary procrastination. Therefore, in addition to the characteristics of ordinary procrastination, two further characteristics are adopted:

1. In computer procrastination, both the delayed activity and the procrastinatory activity take place using a computing device.
2. Because so much computer use – and research about computer use – takes place in an office or professional environment, it seems wise to explicitly recognize that procrastination also occurs at home and on the move, using personal computers, tablet devices, and smart phones.

Combining the above discussion, we arrive at a characterization of the particular phenomenon of computer procrastination:

1. activities using the computer
2. delay of an intended task
3. irrational excuses or self-deception
4. a normative perception of being worse off
5. can take place anywhere, not just the workplace.

6.2.3 *Evidence of Computer Procrastination*

As we'll see in Section 6.4, very little academic research has been performed specifically on computer-related procrastination. However, the anecdotal and non-academic evidence that it is, indeed, a problem seems overwhelming.

6.2.3.1 *Personal experience*

The issue of computer-procrastination being a greater temptation than off-line distractions arises first of all from personal experience: I have found that when working on tasks which require me to spend large segments of time using an internet-connected computer, it is much more difficult to stay focused than when performing otherwise similar manual tasks. For example, when grading papers, if I can take a folder of papers to my writing desk, only three feet away from my computer desk, I find that I am able to grade industriously, with only infrequent interruptions. When performing a similar task at the computer (for example, reviewing student papers which have been submitted electronically) I find that, no matter how mightily I steel my will to the contrary, the number of interruptions and distractions I allow, or even instigate, is significantly higher.

Many of these interruptions, such as checking to see what new emails have arrived, last only a few seconds each. But, the interruption of my thought process significantly slows down my productivity, even after returning to the original task (Bailey & Konstan, 2006). And even worse are the longer breaks that can result when the procrastinating activity continues to sustain my attention after an initial quick look. Examples would include playing online games or watching internet videos.

6.2.3.2 *Anecdotal Observations*

Such experiences of procrastination are not unique to me. In my role as a professor, I have worked with a number of students who have very similar struggles. In many cases, despite good intentions at the beginning, they find themselves with unfinished homework and readings because they have spent hour after hour updating their social networking profile, playing online multi-player games, or watching humorous online videos. As seen in Section 6.4.6, some researchers suggest that in extreme cases, this behaviour ought to be classified as an addiction (Yellowlees & Marks, 2007; Young, 1998).

Early in my research, I posted a message on the social networking site Facebook, asking my friends for examples from their own lives about Internet procrastination. Using blurring to protect the identity of my friends, Figure 3 shows a slightly abridged screen shot of the resulting conversation (Breems, 2009).

While a Facebook "conversation" is not a statistically valid survey instrument, it is clear anecdotally that I am not alone in my finding that computers and the internet present a significant challenge to productivity. Particularly striking is the repeated motif of enhancing productivity by moving away from the computer or removing internet connectivity. For a tool that is popularly portrayed as intrinsically productivity-enhancing, this is remarkable.

Figure 3: Facebook Conversation about Procrastination

Figure 3: Facebook Conversation about Procrastination (cont.)[1]

Many other commentators have also noticed the procrastinatory tendency of online, including one author's accidental discovery that unusually slow internet bandwidth actually increased his writing output (Johnson, 2011), or the lament of an office worker that arranging a number of Google productivity tools into a simple, easily accessible home page made it easy to waste time by over-managing it (Mnookin, 2007).

1 Internet Productivity Comic (February 2008) retrieved from `http://whythatsdelightful.files.wordpress.com/2008/02/rsz_internet_productivity.jpg` Original source unknown.

6.3 research approach

The approach I will use in this "thesis-in-miniature" chapter to investigate the problem of computer procrastination will be similar to the overall approach of the thesis as a whole. Section 6.4 reviews the existing research areas that have some relation to the problem, and finds them wanting in terms of being able to explain the behaviour of computer procrastination fully. This rest of the chapter will then use the techniques of *HUCF Primary Analysis*, *HUCF Existing Research Analysis*, and *HUCF Heatmap Visualization* (introduced in Section 4.5) to analyse both a particular case of computer procrastination, and the existing literature on the subject, in an attempt to better understand the phenomenon, and to devise strategies against it.

The efficacy of this approach can be demonstrated by the insights which result from the analysis. These are detailed in Section 6.7.

6.4 literature on computer procrastination

This section provides a detailed overview of existing bodies of research literature that may have insight to contribute to the discussion of computer procrastination. The first subsection describes the process by which the various areas of research were chosen. Each subsection following that details one of the selected areas, with a particular emphasis put on the limitations of that area in providing a full understanding of the problem. Each of these five areas will be revisited in Section 6.6, where HUCF Existing Research Analysis will be used to gain insight into the contributions each of the existing areas can make to understanding the problem. Doing so will contextualize each area's insight within the larger framework needed to understand computer procrastination as a whole. The HUCF will be used to understand the reasons for each area's limitations, and provide a way to integrate the insights each area provides will be explored.

In the case of the Technology Acceptance Model (TAM) and Human-Computer Interaction (HCI), the literature applies not only to the problem of computer procrastination, but to an understanding of computer use as a whole. Thus, these two areas are also part of the body of literature that inform the entire context in which the HUCF plays its role, and have thus also been more briefly recounted in Section 2.3. The more in-depth treatment in this chapter concentrates on the way in which these areas can contribute to understanding computer procrastination, and not necessarily their contribution to understanding generic computer use situations.

6.4.1 *Selecting the Areas of Literature*

Selecting which areas of literature to examine was an iterative process, in which each paper or source which "came close" to addressing the issue was used to find further research areas which might have insight into the problem. The five areas identified are:

1. Psychological approaches to understanding procrastination
2. Human-Computer Interaction (HCI)
3. Technology Acceptance Model (TAM)
4. Non-Work-Related Internet Use (NWRIU)
5. Problematic Internet Use (PIU)

A brief description of how each of these areas was selected is given below.

PSYCHOLOGY OF PROCRASTINATION Research on general procrastination (i.e., not computer-specific) has been performed primarily from within the field of psychology. For example, Steel (2007) has performed a large meta-analysis of procrastination literature. Categorizing the 250 peer-reviewed references for which the field of study could be determined, by examining the title, journal, and abstract (Breems & Zoetewey, 2010), determined that 221 of those references were from within psychology or one of its sub fields. Very few articles in the psychology literature have discussed computer-specific procrastination. Rather, they discuss procrastination in its generic, everyday sense. The results of this research are relevant here.

For reasons explicated in Section 6.4.2, the field of psychology is unable to comprehensively address the problem of computer procrastination, as it sees only the human side of the problem while the nature of the computer remains opaque. Having failed to find an adequate understanding in psychology because it only can examine one side of the human-machine relationship, the next logical area to examine is the field dedicated to that relationship itself, Human-Computer Interaction.

HUMAN-COMPUTER INTERACTION Using the definition of computer procrastination offered in Section 6.2.2, it is a phenomenon which obviously only arises when a human interacts with a computer; thus one might expect the field of Human-Computer Interaction (HCI) to study computer procrastination. It is thus remarkable that no research into computer procrastination has been performed within this field of study. Some reasons why this might be are summarised in Section 6.4.3.1.

TECHNOLOGY ACCEPTANCE MODEL The field of information systems studies the real life impact of computer use in organizations, and was thus a reasonable next place to look for insight. Davis's (1989) Technology Acceptance Model (TAM) is the pre-eminent model for understanding whether and why users will choose to use an information system. It is an approach that recognizes impact on the life of users as well as interaction with the computer, by distinguishing Perceived Usefulness (PU) from Perceived Ease Of Use (PEOU). TAM spawned a body of research that specializes in predicting when an information system will be accepted and used. Significantly updated and amended by Davis and others, TAM is an influential model (Venkatesh & Bala, 2008), with good predictive power regarding the acceptance or rejection of new information systems (Lee, Kozar, & Larsen, 2003).

If computer procrastination is seen as accepting or adopting the procrastinatory application, one might expect the explanatory power of this well-proven model (Venkatesh, Morris, Davis, & Davis, 2003) to be helpful in understanding the behaviour. However, for reasons that are explained in Section 6.4.4.1, TAM does not address computer procrastination well.

NON-WORK-RELATED INTERNET USE Research into Non-Work-Related Internet Use (NWRIU), "wasting time online", is another area of inquiry that relates to the topic of computer procrastination. It also recognizes the potential for anti-productive tendencies in the computer, such as *cyberslacking* or *cyberloafing* (Garrett & Danziger, 2008; Blanchard & Henle, 2008; Vitak, Crouse, & LaRose, 2011). This has obvious potential to contribute to our understanding of using the computer to avoid working on an intended task, which is a central feature of computer procrastination. NWRIU is studied in business and organizational psychology and is a growing field, drawing on the existing body of research on workplace deviance (Blanchard & Henle, 2008; Lim, 2002).

As will be demonstrated in Section 6.4.5.1, NWRIU's emphasis on rationally-made decisions in the workplace leaves it unable to fully reason about procrastination, which occurs despite the procrastinator's intentions, and potentially in all areas of life rather than only in the workplace.

problematic internet use Computer-related procrastination is just one of many dysfunctions that can occur when computer and internet use become part of our daily lives. The field of psychology has begun to study such dysfunction when it becomes pathological under the name Problematic Internet Use (PIU) (Young & de Abreu, 2011). Problematic internet use differs from simple procrastination in that it includes some of the symptoms of an addiction (Greenfield, 2011), with the user spending such large amounts of their time and energy online that virtually every other area of their life begins to suffer. It often coincides with other pathologies such as loneliness, depression, isolation, and risk-taking behaviours (Davis, Flett, & Besser, 2002). "PIU is a multidimensional syndrome that consists of cognitive, emotional, and behavioural symptoms that result in difficulties with managing one's offline life" (Caplan, Williams, & Yee, 2009). The literature in the field amply demonstrates that computer technology has the capacity, in some circumstances, to shape us in involuntary ways. This is obviously a pertinent observation in relation to the procrastination problem.

6.4.2 *Computer Procrastination and Psychology*

Research on the problem of procrastination in general has been performed primarily from within the field of psychology. Two of the most pertinent results from the psychology literature are a description of the personality traits most likely to suffer from procrastination and the kinds of tasks most likely to be procrastinated on:

personality characteristics The tendency to procrastinate is, to at least some extent, a stable, long-term personality trait (Milgram, Mey-Tal, & Levison, 1998). There are a number of other personality traits which have varying degrees of correlation to procrastination:

- Low conscientiousness (Milgram et al., 1998; Johnson & Bloom, 1995)
- Low self-efficacy and self-esteem (Milgram et al., 1998)
- Irrational beliefs (Soloman & Rothblum, 1984; Brownlow & Reasinger, 2000)
- Self-handicapping (Milgram et al., 1998; Ferrari & Tice, 2000)
- Impulsiveness (Blatt & Quinlan, 1967; Schouwenburg & Lay, 1995)

TASK CHARACTERISTICS In addition to the likelihood of procrastination depending on the individual person involved, it also has significant correlations with the nature of the task. Two majors contributions that the nature of the task imposes are:

- Timing of rewards (procrastination is more likely to occur when the reward is distant and/or the aversiveness is near) (Schouwenburg & Groenewoud, 2001; Strongman & Burt, 2000; O'Donoghue & Rabin, 1999)
- Task aversiveness (Kachgal, Hansen, & Nutter, 2001; Peterson, 1987)

This general understanding of the correlates of procrastination provides a context in which we can begin to ask why the computer would make procrastination a particularly tempting option. Since computer procrastination is specified as a certain class of task (i.e., tasks which use a computer), one promising avenue is examining the task characteristics of computer use that might contribute towards procrastination.

For example, the use of a modern, multitasking computer alters the timing of rewards and punishments to some extent. That is, the very design of the operating system offers the ubiquitous ability to easily switch applications with minimal effort. This ability creates an environment ripe for procrastination, by providing an opportunity to escape an aversive task without having to admit (to ourselves) that we won't be back at our original task any time soon.

6.4.2.1 *Study by Lavoie and Pychyl*

Only one psychological study has directly examined the particular connection between procrastination and internet use, performed by Lavoie & Pychyl (2001). They collected data using an online survey, gathering participants from undergraduate students (who completed the survey at the request of their professor) and from users performing web searches for "procrastination". This methodology for gathering data leaves significant room for various forms of sampling bias, and demonstrates the need for further research in this area. Despite both methodological concerns and the age of the study in the fast-moving internet world, the results of the survey are noteworthy: Over half of the respondents indicated that regular, significant procrastination was a problem when they were online. An astounding 47% of online time was reported to be procrastinatory in nature.

In addition to the statistical results, the reasoning used in the authors' discussion of the results is also intriguing. They propose that the idea of *technological bias* proposed in Postman's (1993) book *Technopoly* offers significant explanatory power. *Technological bias* refers to the misconception that the use of technology *intrinsically* results in increased productivity and efficiency. Users who unconsciously hold this belief will be less able to accurately monitor and evaluate the actual results of their internet use, and will continue to see the internet as an important and useful tool when the reality is that it may be hurting their productivity as much as helping it.

Lavoie & Pychyl (2001) also suggest that in addition to the user's attitudes, the nature of the technology itself – it is instantaneous, available in small chunks of time, and easy to switch between applications – make it a powerful temptation towards procrastination. They explain this by referring to reasoning introduced by Silver & Sabini (1981). Silver and Sabini point out that in one frequent kind of procrastination, the procrastinator avoids overt cognitive dissonance by maintaining a "procrastination field." This is a situation in which they maintain their position and their environment in a ready-to-work state, in order to convince themselves that they're not actually procrastinating. The most attractive procrastinatory activities in these cases will thus tend to be those which can be performed from the same physical position as the work, switched to quickly, give immediate satisfaction, and can be discontinued at will. Many computer distractions fit this description perfectly.

A second point that Silver & Sabini (1981) make is that a person who is committed to a task which they find aversive may not decide to take a break, but instead may subconsciously seek sub-tasks which are substantially off-task while maintaining the appearance of contributing towards meeting the long-term goal. The internet is ripe for distractions of this type. For example, many forms of office work legitimately require internet research. The distractions inherent in this research form a constant temptation to procrastinate. It is the nature of hyperlinks to be clicked. Our curiosity is often piqued by the reference in the current document, and we wonder what the linked document may contain. Because the amount of time and commitment it requires to follow the link seems negligible, and because it still feels, psychologically, like performing real work, it is relatively easy to follow hyperlinks that are not relevant to the task at hand, and thus, without intending, to "find ourselves procrastinating" by reading miscellaneous Wikipedia articles, blog posts, news articles, etc.

6.4.2.2 *Limitations*

The single study by Lavoie & Pychyl (2001) notwithstanding, surprisingly little research in psychology has been performed on the specific issue of procrastination using a computer. While there is a lot of work in tangentially related areas, such as problematic internet use (from a clinical perspective) and non-work-related internet use (from an organizational perspective), the question "Is procrastination a worse problem when using a computer than when doing a similar task manually?" is entirely untested in the literature. Though the anecdotal evidence in favour of an affirmative answer is strong (see Section 6.2.3.2), and the tangentially related fields have proved that online procrastination is indeed a problem in a variety of contexts, the lack of solid empirical testing of this important question represents a significant hole in the research literature.

Second, because the field of psychology is focused on the nature of the human being, it is not a suitable field for asking questions about the nature of the computer technology itself. Without being able to meaningfully ask such questions, however, the precise nature of the task characteristics which impel the user towards procrastination will remain opaque, and the hope of design alternatives which could ameliorate the problem will remain unfulfilled. We thus require a framework which can incorporate the many important insights from psychology, but also is able to see the larger picture of both the human and the computer in their interaction. The various tendencies that emerge out of human use of computers come about because of the interplay of both the human and the machine. Ignoring the nature of the technology, and the proclivities which have been embedded in it, will result in half of the problem being missed.

6.4.3 *Human-Computer Interaction*

Research in Human-Computer Interaction (HCI) covers many areas of human functioning which are potentially relevant to procrastination. The fields of affective computing and attention-aware computing have particular relevance:

- HCI takes consideration of the nature of the user as a non-abstracted human. For example, recent developments in *affective computing* attempt to detect, model, and appropriately respond to the user's affective state (Zeng, Pantic, Roisman, & Huang, 2009; Hudlicka, 2003). Procrastination has significant affective correlations, such as anxiety (Rothblum, Solomon, & Murakami, 1986; van Eerde, 2003), depression (van Eerde, 2003), boredom (Vodanovich & Rupp, 1999), and frustration (Bessière, Newhagen, Robinson, & Shneiderman, 2006), either as antecedent or consequence. Software which can detect the user's affective condition provides hope for design techniques which can respond intelligently to latent or actual procrastination possibilities.

- There is research into the procrastination-related area of *attention*, known as "attention-aware computing" (Bailey & Konstan, 2006). Because in most cases procrastination involves the distraction of our attention away from the task at hand, software which can track the user's attention and respond intelligently has the opportunity to prod the user towards productivity at a time when such prodding is most needed.

Software which can detect the user's affective condition and track attention provides hope for design techniques which can respond intelligently to latent or actual procrastination possibilities. Given this potential, it is remarkable that no research into computer procrastination has been performed within this field of study.

6.4.3.1 *Limitations*

There might be three reasons why the study of computer procrastination is beyond the core interests of the field of HCI:

1. HCI research focuses on the performance of given applications, or single, predefined tasks, whereas computer procrastination, by definition, involves not only the procrastinated application or task, but also one or an in-

definite number of distracting applications. Examining how the user interacts with the application on its own terms will miss the procrastinatory behaviour entirely. Computer procrastination is more a matter of the user interaction with attractively meaningful information content than interaction with an interface.

2. What makes computer procrastination meaningful as an issue is its possibly deleterious effect on the everyday life of the user. HCI as currently constituted does not study this; it can only study the interactions by which effects might occur, but not the effects themselves.
3. Normativity is important to the topic of computer procrastination: the prediction of whether the distraction will be deleterious or not requires normative reasoning by the user. HCI does not provide this.

While a leading HCI research journal nominally includes interest in "design as it affects individual users" in its aims and scope Human Computer Interaction (2014), the extant research of the field focuses much more heavily on the performance of an application in solving the precise task or problem which that particular application is designed to address (Dix et al., 2004, p. 5). That is, it seeks to ask and answer questions like "How can the human and the computer work together to solve such-and-such a problem or perform this-or-that task?"

Understanding computer procrastination, however, requires the ability to look beyond the actual problem or area that an application or information system is attempting to address, precisely because it is behaviour that happens when the user interrupts the normal flow of task activity, frequently by leaving the application or information system itself.

We thus require a way of looking at computer use that takes seriously the importance of everyday experience and allows us to examine the impact of computer use from a larger perspective. That the HCI community as it stands does not currently provide such a lens suggests an important challenge to this community. Indeed, given the interest in the effects of the computer on the user, and the focus on, for example, issues of attention and distraction, it is remarkable that no research into procrastination with computers has been performed by this field of study.

We can conclude that the HCI research community can provide valuable insight into understanding the problem of procrastination, can perhaps assist in the design of interfaces that reduce procrastination, and is one of the proper places for the problem to be studied, but at this time a comprehensive understanding of the everyday experience of procrastination with computers cannot be achieved from within the HCI research area, but must be informed by fields outside HCI that recognize engagement with meaningful content, with everyday life beyond computer use, and normativity.

6.4.4 *Technology Acceptance Model*

The Technology Acceptance Model (TAM) body of research, introduced in Section 2.3, predicts whether an information system (or a part thereof) will be accepted and used by the members of an organization. Because it has good predictive power regarding the acceptance or rejection of new information systems, it is possible that procrastination might be seen in TAM terms, either as lessening the use of the original application, or as adoption of the procrastinatory application.

6.4.4.1 *Limitations*

There are a number of reasons why, despite its huge success in the IS field for predicting usage, the TAM model is not useful to us in predicting procrastination.

First, the notion of *usefulness* being tested by Davis and subsequent implementers of this model tests only *perceived useful-*

ness, rather than actual usefulness (Davis, 1989). From what we have seen about the dysfunctional nature of computer procrastination, it takes place *despite* the user's knowledge that they will be worse off for the delay. It thus makes no sense to question whether or not the procrastination is perceived to be *useful*, since our definition requires that it is not.

A second limitation is that the TAM model reasons about the user's attitude towards and intention to use an *information system*. What this means is not further defined, but in general it will be a single application or small suite of applications used in concert for a single purpose. When the computer tempts toward procrastination, however, it most often does so through the availability of alternate applications which the user could be using, rather than the ones that make up the information system under consideration. For example, if a user switches from a data entry application to play a solitaire game application, that is not a use situation that can be understood with reference only to the data entry application; it is a possibility designed into the functioning of modern operating systems. Because of this, procrastination can be viewed as somewhat *external* to the information system being studied, thus falling outside the purview of an information system use model such as TAM.

Third, the TAM model is predictive, but not prescriptive. That is, it doesn't provide any guidance on questions of *ought*. It begins with the simple assumption that adoption and use of the system are an appropriate goal, and provides tools for understanding (and thus eventually overcoming) user resistance. In his introduction to a special journal issue concentrating on TAM, Hirschheim (2007) suggests that one of the original motivating questions of TAM is: "How do we get individuals to adopt and use the systems that are implemented?" (p. 204) The model as such is frankly disrespectful towards the users, as it simply assumes that the user's resistance is something to be overcome rather than championed (Venkatesh & Bala, 2008, p. 294). Because it can't address questions of normativity, it is unable to differentiate between situations where user resistance is appropriate and when it is not. The lack of evaluative criteria for judging whether or not system use *ought* to be pursued is not a direct criticism of TAM itself, as TAM makes no claim to provide that kind of guidance. However, without the ability to ask such questions, it makes a poor dominant model for understanding the acceptance and use of information systems.

Finally, TAM's foundation on the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975) and its descendant, the Theory of Blanned Behaviour (TPB) (Ajzen, 1991), is troublesome for the case of procrastination, because in procrastination, we clearly have a situation in which the person's intentions do not have the expected effect on their behaviour. Talking about the adoption of a particular use of a technology by reasoning about the person's intention to use that technology in a particular way is irrelevant in the case of procrastination, because procrastination requires that the person be acting contrary to their intentions in the first place.

6.4.5 *Non-Work-Related Internet Use*

Research into Non-Work-Related Internet Use (NWRIU) also recognizes the potential for anti-productive tendencies in the computer. Often referred to somewhat pejoratively as *cyberslacking* or *cyberloafing*, this activity is studied in business and organizational psychology. This growing field draws on the existing body of research on workplace deviance (Blanchard & Henle, 2008; Lim, 2002), at-work behaviour which results in reduced employee productivity. [2]

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2 Blau, Yang, & Ward-Cook (2006), make the argument that while simple web surfing may best be described only as production deviance, in general cyberloafing utilizes company-owned resources (in particular, the personal computer and the internet bandwidth) for personal purposes and thus might be better classified as the more organizationally serious *property deviance*, similar to pilfering office supplies, since these resources are not, at that time, being utilized to the profit of the employer.

This is a research field that is still actively developing and maturing. As such, there has been a stream of research attempting to explain this behaviour by investigating a wide variety of antecedents for this behaviour. Among the psychological and organizational factors that have been studied for correlation with NWRIU, it has been found that those more likely to avoid their work by wasting time online include: Employees who perceive unfair treatment (Blau et al., 2006; Lim, 2002), employees who perceive that their co-workers' and institutional norms allow it (Blanchard & Henle, 2008; Liberman et al., 2011), employees with an *external locus of control* (Blau et al., 2006; Blanchard & Henle, 2008) (although this hypothesis was not supported by Vitak et al. (2011)), males, younger people, and minority groups (Vitak et al., 2011), and people with a lot of computer experience who expect that computer use will generally produce better outcomes (Garrett & Danziger, 2008; Vitak et al., 2011).

While specific studies testing the efficacy of various amelioration strategies are limited, many papers include suggested approaches in the discussion of their research findings. For example, Blanchard & Henle (2008) suggest that, because the role of organizational norms only appears to affect the more minor forms of cyberloafing, publishing such expectations in the form of an *acceptable use policy* is unlikely to be entirely effective. Rather, their finding that major cyberloafing activities correlate to the perception of an external locus of control suggests that a robust internet monitoring policy with effective follow-up and enforcement may deter some of this undesirable activity.

6.4.5.1 *Limitations*

The general tendency of research in the area of non-work-related computing is to implicitly assume that any employee who wastes time online must be doing so because of some rational choice. For example, Lim (2002) suggests that they are maintaining a mental *ledger* of effort given and reward received, while Garrett & Danziger (2008) suggest a simple economic calculus of expected outcome. These may be inadequate explanations.

As one example, consider Blanchard & Henle (2008). They note that some of the most serious cyberloafing offenders spend inordinate amounts of time in online gambling or visiting adult-oriented web sites. However, they fail to acknowledge that both compulsive gambling and pathological pornography viewing are recognized disorders (American Psychiatric Association, 2000; Kafka, 2010). This is significant, because in these cases, it is entirely possible, or even likely, that the behaviour occurs at or beyond the boundary of the user's conscious control. It is the very nature of addiction and compulsion that, to some extent, the person can no longer help themselves. Thus, if a pathological internet gambler has access to the internet at work, then their problem will follow them to the workplace. Searching for an explanation in terms of, for example, disaffection, perceived injustice, or external locus of control, seems unlikely to contribute much additional insight in that situation.

By relying on organizational or social-psychological explanations about the employee intentionally sabotaging their productivity, and thus ignoring the possibility that the user earnestly wishes to be more productive with the computer, this research misses out on potential avenues of fruitful insight, such as questioning what it is in the nature of the technology itself which may exhibit a procrastinatory tendency. This forms a significant critique of the extant research in this young field of study.

For this reason, explaining computer procrastination through the lens of this research literature fails. Instead of conscious action taken as the result of rational choice, in procrastination we have a situation in which the user (the employee, in the case of NWRIU) *wants* to work productively, but instead finds themselves procrastinating online.

One of the original definitions a procrastinator given by Silver and Sabini (1981) was: "Someone who knows what (s)he wants to do, in some sense can do it, is trying to do it, yet doesn't do it" (p. 207). Unfortunately, the phrase "in some sense" in that definition introduces a tension; as Pychyl (2011) points out, procrastination may be a problem because of unconscious urges and predilections which are outside of our ability to control, but the very definition of procrastination which we're using requires some component of *voluntary* choice. This interplay between voluntary action and succumbing to unconscious or partially conscious urges and temptations is not addressed by the NWRIU research.

A second limitation of this research is the lack of a well-defined normative basis for determining whether or not a given use of the internet is appropriate or not. Blanchard & Henle (2008) make a distinction between major and minor cyberloafing in terms of the appropriateness of the behaviour, recognizing that under some conditions, some minor cyberslacking may indeed be appropriate, while the serious forms (such as visiting adult-oriented websites, downloading music, participating in chat rooms, or maintaining a personal web site) are always inappropriate. This discussion begs the question of how appropriate is determined. Meaningful consideration of off-task behaviour depends on an understanding of what is normative behaviour in a given context. While Blanchard & Henle (2008) include the *perceived contextual norms* in their discussion – determining to what extent employees think their co-workers and supervisors would approve of their internet activity – they don't consider the question of what can *actually* be considered normative in a workplace context. While it is not uncommon for both employees and employers to agree that some strictly personal activities may be appropriate in the workplace, NWRIU research loses richness by ignoring the question of what kinds of activities actually *ought* to be acceptable. The use of a larger philosophical framework for understanding the role of computer technology could help to provide this.

6.4.6 *Problematic Internet Use*

Computer-related procrastination is just one of many dysfunctions that can occur when computer and internet use become part of our daily lives. The field of psychology has begun to study such dysfunction when it becomes pathological, often called Problematic Internet Use (PIU) (Young & de Abreu, 2011). PIU differs from simple procrastination in that it includes some of the symptoms of an addiction (Greenfield, 2011), with the user spending such large amounts of their time and energy online that virtually every other area of their life begins to suffer. It often coincides with other pathologies such as loneliness, depression, isolation, and risk-taking behaviours (Davis et al., 2002). "PIU is a multidimensional syndrome that consists of cognitive, emotional, and behavioural symptoms that result in difficulties with managing one's offline life" (Caplan, Williams, & Yee, 2009, p. 1313). There continues to be significant debate over the correct term to use when taking about pathological computer and internet problems. Some researchers, pointing to similarities with other kinds of addiction, compulsive gambling in particular, prefer to call it "internet addiction" (Yellowlees & Marks, 2007), while others prefer the somewhat less baggage-laden "problematic internet use" (Davis et al., 2002).

The issue has been studied with emphasis on its role among university undergraduates (Frangos, Frangos, & Sotiropoulos, 2011), in the office (Thatcher, Wretschkochko, & Fisherd, 2008), among game players (Caplan et al., 2009), or for pre-employment screening (Davis et al., 2002). While some studies concentrate on the causes of the problem (Greenfield, 2011; Shi, Chen, & Tian, 2011; Young, Yue, & Ying, 2011), others examine the impact on the individual users' lives (Caplan et al., 2009; Frangos et al., 2011), and others concentrate on clinical approaches to helping those who suffer from this dysfunction (Geranios, 2009; de Abreu & Góes, 2011; Beard, 2011).

The literature in the field amply demonstrates that computer technology has the capacity, in some circumstances, to shape us in involuntary ways. This is obviously a pertinent observation in relation to the procrastination problem.

6.4.6.1 *Limitations*

While this research is doubtlessly helpful to psychology practitioners assisting people who suffer from this pathological condition, it is only partially relevant to more general computer procrastination. A given behaviour only falls under the purview of this research when the dysfunction has become so intense that it must be considered abnormal, and requires clinical intervention. Only a relatively small portion of the computer-using population suffers from the debilitating effects of a full-scale internet addiction. The concern of this chapter, however, is not with this uncommon (though doubtlessly serious) problem, but is rather with the common, everyday experience that the majority have when using computers. The perceived tendency towards distraction and procrastination that affects otherwise healthy, balanced individuals is also worth our consideration. Indeed, the cumulative effects of any such tendencies, when considered at the society-wide scale of computer and internet use, seem likely to significantly outweigh the relatively less frequent, though more severe, life impact of PIU.

In addition, the research into Problematic Internet Use most commonly focuses on the human side of the problem, on what it is in the individual user that causes the dysfunction, and then looks to psychology for clues on how to help them. The relatively small fraction of the population that suffers from this situation indicates that the precise causes are more likely to be found in the individual persons than in the technology itself. However, when it comes to more general procrastination, the opposite is true. The fact that a relatively large portion of the population experiences the procrastinatory pull of the computer, and that this is happening in otherwise healthy, productive, well-balanced individuals, seems to point to the nature of the technology itself as a fruitful area of inquiry when looking for both explanation and solution to this problem.

One study which begins to examine why the internet is such a powerful temptation for abuse is performed by Greenfield (2011), in which he discusses the properties of the internet that contribute towards abuse and dependence among his patients. After an overview of the neuropsychology of addiction, primarily focusing on the role of dopamine, he compares internet addiction to other forms of addition. He shows that it meets several candidate "markers" for addiction, such as DIAR: Desire to Stop, Inability to Stop, Attempt to Stop, Relapse. Another hallmark that PIU shares with addiction is the pattern of tolerance and withdrawal. The most important contribution that Greenfield provides about computer technology is his hypotheses on what characteristics of technology give it its addictive potential. He suggests 5:

CONTENT FACTORS The Internet content itself is frequently stimulating.

PROCESS AND ACCESS/AVAILABILITY FACTORS The internet appears to amplify personal power, and when combined with ease, dis-inhibition, and anonymity, internet use provides the illusion of unfettered experience that is very psychologically attractive.

REINFORCEMENT/REWARD FACTORS The psychological rewards of internet use are unpredictable in both their frequency and their strength. The notion that there may be "gold" hidden behind the next hyper-link, or that an emotionally satisfying text may arrive "at any time", enhances the addictive quality.

SOCIAL FACTORS The social interaction that is typical of the internet allows users to exercise unusually tight control over their social interactions. They can attempt meet their social needs without the perceived emotional risks of unpredictable, face-to-face, real time connections.

GEN-D FACTORS The cultural milieu of "Generation Digital" often includes situations where parents and other adults are less familiar with the technology than the younger generation. This situation reduces the ability of adults to monitor and intervene when warning signs of early PIU show up.

Greenfield (2011) concludes with an insightful call for thoughtfulness and care in evaluating and accepting new digital technologies in our lives. He notes that it is not merely human propensities that provide the addictive potential for internet technologies, but also the nature of the technology itself that, in concert with the human nature of the users, invokes these tendencies.

6.4.7 *Summary of Extant Research*

The problem of procrastination when using computers has close relations to a variety of research areas. Table 9 summarizes these and shows that each of these approaches provides some key insights into the problem, but ultimately has limitations which render it unable to address this problem as a whole. A framework is needed which can incorporate the important insight from each of these separate research areas, take the everyday experience of computer use seriously, ensure that no important areas are missed, and is practical enough to indicate potential solutions.

Table 10 summarises the above discussion, showing to what extent each area of research might provide insight into each of the five characteristics identified in Section 6.2.2 as important in computer procrastination. Each '+' indicates a better contribution, while a '-' indicates that the assumptions made in the area might actively mislead.

AREA OF EXTENT RESEARCH	INSIGHTS THIS RESEARCH AREA CONTRIBUTES	LIMITATIONS OF THIS RESEARCH
Procrastination and Psychology	Predicts which kinds of individuals are more likely to have a procrastination problem Provides a history of reasoning about why some tasks introduce a greater procrastinatory tendency than others.	Surprising lack of research specifically into procrastination with computers. Not able to effectively ask questions about nature of technology and human interaction
HCI Community	Can situate this particular kind of "user interaction" within a larger body of work Concerned with understanding the role of attention and the cognitive and affective state of the user in effective computer use.	Surprisingly, no research directly into procrastination has been done from within the community. Much of the emphasis in is at a lower level than the concerns of procrastination; rather, clarity of the symbolic interaction between user and computer is the focus.
Technology Acceptance Model	Provides good predictive power for determining which kinds of technology are likely to be accepted and used.	Doesn't directly address the actual issue of procrastination Strictly restricted to the notion of perceptions of performance, and only in the workplace. Does not provide normative guidance for questions of whether IS adoption is a suitable goal. TAM's assumption that intention will lead to behaviour is violated in the case of procrastination.
Non-Work-Related Internet Use	Verifies the double-sided effects of workplace information technology Reveals how extensive the problem can be Shows numerous antecedents that are associated with this behaviour	Is about the workplace; does not consider "everyday" use in the home, school, etc... Focused exclusively on the situation where the behaviour is entirely intentional and voluntary; ignores the situation of the employee who *wants* to be more productive at work, but finds themselves distracted and procrastinating Relies on the notion of *inappropriate* workplace usage, but provides no normative basis for judging appropriateness.
Problematic Internet Use	Clinically useful for helping those with severe life dysfunction due to computer and internet use Demonstrates the ability of the technology itself to shape us in involuntary ways	Focused exclusively on abnormal situations requiring clinical intervention Is concerned with the individual patient, and the psychological conditions that are leading to the problem; ignores the nature of the computer and internet which produce this procrastinatory tendency

Table 9: Summary of Research Fields Related to Computer Procrastination

Research Area	Uses Computer	Delay	Irrationality	Normativity	Anywhere
Psychology		++	+++		+
Human-computer Interaction	+++	+			++
Technology Acceptance Model	++		-	+ / - -	- -
Non-work Internet Use	+++	++	- -	- -	- -
Problematic Internet Use	+++	+ / -	++	+	++

Table 10: Summary of extant research's ability to address main issues in computer procrastination

It can be seen that no area of research can provide good insights for all factors. Most have blank areas, indicating no insight in this area, and some would actively mislead. Why is this? What is it about computer procrastination that makes this so? A framework is needed by which the nature of computer procrastination can be understood in its entirety, and by which the capabilities and limitations of each area may be understood.

6.5 hucf primary analysis of procrastination

The following detailed example illustrates the use of the framework in understanding procrastination. It demonstrates how procrastination can result from the interplay between the 15 modal aspects, and the distinctions between HCI, EMC, and HLC functionings.

The following narrative demonstrates a recent, real-world example of personal procrastination.

> While working on a short blog entry related to my research, I became anxious and frustrated about my research progress. Feeling unengaged in the blog writing, I switched to a new browser window, navigated to a game site and played an online version of the old dice game *Yahtzee*. In this game, the player

> must choose to keep some dice rolls and re-throw others in an attempt to maximize the end score. It seems that no matter how mightily I steel my will to the contrary, and no matter the feelings of guilt and stress that result, this kind of online procrastination continually sneaks into my life and disrupts my productivity.

A screen shot of the Yahtzee game is shown in Figure 4.

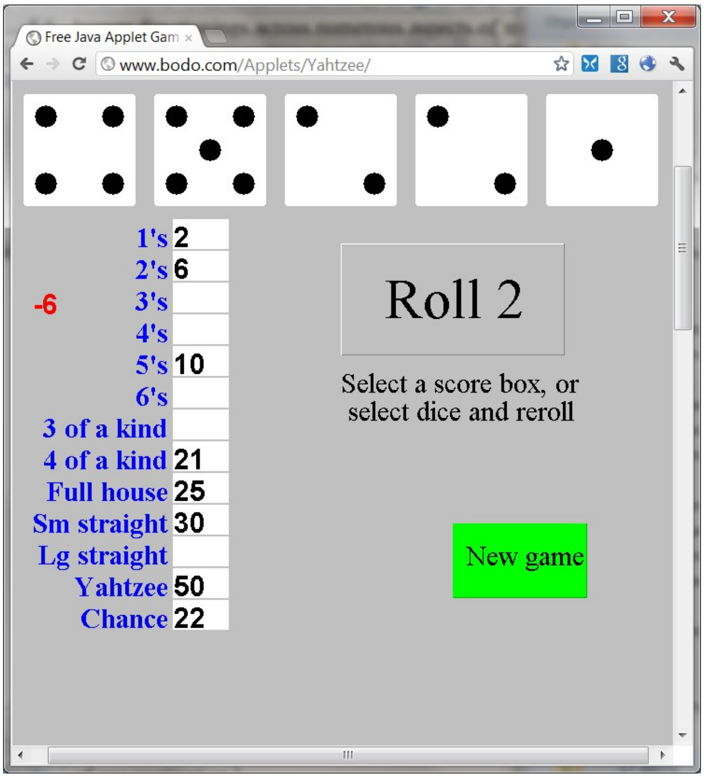

Figure 4: Screen shot of the Yahtzee Game

The HUCF primary analysis of this situation is presented in Table 11.

To provide insight into the generation of this table, a small sample of these cells is explored in additional detail below:

SPATIAL/HCI Modern Graphical User Interface (GUI)-based operating systems place windows on the screen in an emulation of layers of paper laying on a desktop. (The metaphor of the desktop itself is still with us, but in re-

Aspects	HCI (Human/Computer Interaction)	EMC (Engaging with Meaningful Content)	HLC (Human Living with Computers)
QUANTITATIVE (discrete number)	*Number* of buttons on main window *Number* of open applications vying for my attention	*Number* of dice *Numbers* on the dice Score	*Number* of times I say “just one more game”
SPATIAL	*Distance* I have to move mouse to change applications *Arrangement* of windows and components on screen		Game is in the same *space* as my legitimate work
KINEMATIC (movement)	*Movement* of mouse, both on desk and on screen	Dice ought to appear to *roll* on screen (*movement*) but instead they *instantaneously* change to their final value	Very little *movement* between work and procrastination, just press a few keys or move the mouse a short distance
PHYSICAL	*Forces* required to move mouse, press buttons		Sitting *still*, very low *energy* expenditure Sense of *Inertia*
BIOTIC		*Dead* game; no sense of *flourishing*	Tense *muscles*, strained *eyes* from quick playing
PSYCHIC / SENSITIVE (Perception, feelings, emotions)	*Visual perception* of the screen *Tactile perception* of the mouse	*Feelings* of *pleasure*, *enjoyment*, “mindless diversion”	*Anxiety*, *frustration*, and the “I don't feel like doing this” unengaged *feelings* of writing the blog entry *Feelings* of *guilt*, *stress*, from not getting things done
ANALYTICAL (Distinction)	Score card interface *differentiates* various ways of gaining points	*Analysis* of what action has the highest probability of a high score *Distinguish* between *optimal* and *suboptimal*	*Rationalization* *Distinguishing* between hard work with positive long-term results and “fun now” with lesser-but-immediate rewards “Running on *autopilot*”, playing without deep *thinking*
FORMATIVE (Shaping, creating culture)	Dice, Scorecard, and action buttons *form* miniature *world* of Yahtzee	*Building* a game by *making choices* early on that will impact possibilities later	Nothing of substance is *built* or *shaped* “...no matter how mightily I steel my *will* to the contrary...” implies failure of *formative willpower*. The *attentional* attraction of the game scatters my *attention* away from the task at hand (Talbott 1995)
LINGUAL (Symbolic meaning)	*Simple*, *clear* pictorial *symbols* allow easy interaction	Dice and score card have numeric and game-play *significance*	
SOCIAL		Yahtzee was originally designed as a *multi-player* game, but this online version is only *single* player.	Ignoring important task is a form of *disrespect* towards those who are counting on me to perform that task
ECONOMIC	Relatively *compact* game makes *economy* of screen space simple to achieve	Each turn can *only be used* in one way, must be *frugal* with dice-roll *opportunities*	*Waste* of time

Table 11: HUCF Primary Analysis of Procrastination

Aspects	**HCI (Human/Computer Interaction)**	**EMC (Engaging with Meaningful Content)**	**HLC (Human Living with Computers)**
AESTHETIC (beauty, harmony, fun)	*Crude* screen images are *ugly*	Filling out the score card and working the probabilities provides *aesthetic satisfaction*. It's *fun*.	Ought to be sense of *fun*, *harmony*, and simple *pleasure*; on deeper level, play is *unsatisfying* Writing the blog entry was *boring* or *unengaging*
JURIDICAL (Justice, giving what is due)	The interface gives *due* to the simple information contained in the dice, displaying the value using the standard pattern of dots	Each scoring category has a certain number of points possible; there is a (limited) sense of *injustice* when a category is underutilized.	My *responsibilities* to others, myself, and to God include casual enjoyment, but *inordinate* amounts of time take away from the rest of my calling. Feelings of *guilt* (see psychic/sensitive) result from failures in this aspect.
ETHICAL (love, self-giving)	The user interface feels *miserly* – the programmer didn't spend *extra* time making it look and feel nice		Procrastination is *self-centered*; it is giving in to *selfish*, short-term feelings rather than *self-giving* and working hard to *benefit* the common good.
PISTIC (faith, trust, self-vision)		*Trust* in the rules of probability	I *break faith* with students, supervisor, or family when I delay on tasks I have *agreed* to accomplish Chronic delay in living out who *we see ourselves* to be *breaks faith* with *religious convictions* Procrastination as an *existential crisis* of "living in bad faith,"(Pychyl 2008) *self-deception*, and flight from *responsibility*.

Table 11: HUCF Primary Analysis of Procrastination(cont.)

cent years the implementation of that metaphor is becoming more abstract.) This SPATIAL arrangement is not necessarily what makes the switching between applications possible, but it does create the PSYCHIC perception that all of the applications are, in some sense, present and available simultaneously. While this is true from the computer's point of view, human attention can only focus on one thing at a time. Thus, the arrangement of windows, and even the notion that an off-screen application is "hidden behind the current window" create a mental environment in which switching between applications regularly is a constant possibility. This is, of course, by design, and is frequently a productivity-enhancing feature of modern desktop operating systems.

ANALYTICAL/HCI The layout of the interface for the Yahtzee game makes it very easy to differentiate the scoring categories in the game, and to select the one you want to apply to the current dice role. Simply clicking inside any of the white scoring boxes (see Figure 4) selects that category for the current roll, which is how *distinguishing* is operationalized in the interface. It then calculates the score, and advances to roll the dice for the next turn. Because the interface's design is based off the paper score card from the original Yahtzee game, this design is familiar and easy to navigate for any who have played the paper-based game.

LINGUAL/HCI The simple pictograms of the dice faces are nearly universally recognisable in most cultures. The labels on the scoring categories are simple, though involving some abbreviation that must be deciphered.

AESTHETIC/HCI The blocky graphics and drab colour choices suggest an amateur design rather than a professionally developed software product. This does not hamper gameplay in any real sense, but does reduce the enjoyment of the game some.

QUANTITATIVE/EMC The nature of the dice game Yahtzee is strongly centred around the QUANTITATIVE aspect. The arithmetic of probability on how likely certain combinations are to come up in future rolls must be constantly calculated when deciding which dice to re-roll and which score categories to use. (The analysis itself is in the ANALYTICAL aspect, and the numbers themselves on screen are LINGUAL, but the probabilities underlying these calculations are QUANTITATIVE in nature.)

FORMATIVE/EMC Making choices that will constrain (or expand) the scope in which our future choices can be made is a central part of the FORMATIVE aspect. Within the content of the Yahtzee game, once a particular scoring category has been used, it cannot be used again.

SOCIAL/EMC The original paper-based game was intended to be played with multiple players. By limiting play to a single player, this computer version almost eliminates SOCIAL functioning from the EMC category of functioning. However, for players who are familiar with the original paper-based version of the game, this lack of social interaction creates a noticeable absence in playing the game, and is a form of SOCIAL functioning in itself.

QUANTITATIVE/HLC One of the features of the Yahtzee game that makes it such a difficult temptation for procrastination is the size of the discrete chunks of gameplay. If each game required several hours to complete, it would be much easier to say "No, I don't have time for this right now, I need to get back to work" whereas with each game taking only one or two minutes, the rationalization of saying "just one more game" is much easier to deceive myself with.

KINEMATIC/HLC The very low movement threshold for changing from the productive task to the procrastinatory task is a central part of the enabling nature computers for procrastination. The *inertia* (see PHYSICAL/HLC) of sitting still allows me to, psychologically, feel as though I haven't left the supposedly productive position in which I started to go do a separate "goofing off" activity.

PSYCHIC/SENSITIVE/HLC This aspectual functioning category is perhaps the sharpest demonstration of the distinction between HCI, EMC and HLC functioning. The simultaneous perception of, enjoyment of, and abhorrence of the procrastinatory activity demonstrates the triple nature of my PSYCHIC functioning with the software's functionality. The unpleasantness and aversiveness of the feelings in PSYCHIC/SENSITIVE/HLC functioning may be a key area for addressing the procrastinatory problem. If these feelings could be capitalised upon to poison the entire experience, the procrastination may be less likely to take place. This possibility is explored in Section 6.7.5.

PISTIC/HLC The notion of "breaking faith" with my colleagues by delaying the writing of a blog entry that has been promised, and "living in bad faith" by not carrying out my own internal commitments, help indicate the identity-forming dysfunction inherent in chronic procrastination. In this category, the carrying out of the HUCF analysis can itself be a catalyst for honest self-assessment and introspection, and can lead to renewed efforts at positive change. This is further explored in Section 8.5.

When I analyse which entries in Table 11 seem of special importance to the problem of procrastination, I can use the technique of HUCF Heatmap visualization to build an aspectual profile. This is presented in Figure 5 with darker shades indicating greater significance.

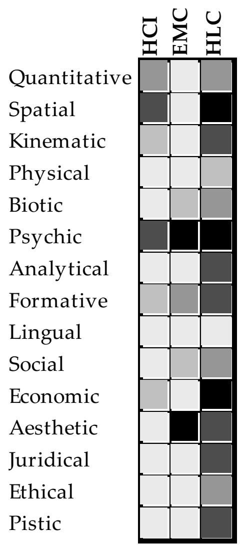

Figure 5: Heat map diagram of computer and internet procrastination using HUCF framework

6.6 HUCF EXISTING RESEARCH ANALYSIS

In the literature review of the research areas in Section 6.4, it can be seen that each can provide insight, but none can, by itself, provide a complete understanding of the problem of computer procrastination. (These conclusions are detailed in the "Limitations" sections of the respective subsections of Section 6.4.) What remains unclear, however, is both *why* each area seems to overlook the problem of computer procrastination, and how the insights of each area could be appreciated in concert with the other areas, when applied to that problem.

The comprehensive nature of Dooyeweerd's suite of aspects allows Basden's HUCF to increase understanding and appreciation of existing research by meaningfully accounting for both the insights and the limitations of other fields of study. Thus, in this section, each area of literature is visited a second time. The first time, in section 6.4, introduced each area, showed how that area can bring some insight to the problem of computer procrastination, and detailed why it is unable to provide a full account of the phenomenon. The second time, in this section, will use the techniques of *HUCF Existing Research Analysis* and *HUCF Heatmap Visualization* to analyse each area, showing how the framework can help to understand the area, and providing a way to account for both the insights and limitations of each research area. In this way, incorporating insight from multiple, diverse streams of research in an integrated fashion becomes possible.

Key insights from each surveyed research area, and some limitations of each, were summarized in Table 9 on page 154. After performing the *HUCF Existing Research Analysis* of each area, the following questions about that area can be answered:

1. How does the framework see this area?
2. How can the framework account for each insight in this area?
3. How can the framework account for each limitation in this area?

To help understand the answer to the first question for each area, an HUCF heatmap has been constructed in each case, as described in Section 4.5.3. This depicts visually which aspects and functionings within the HUCF that area focuses most heavily on. The last two questions look at how the HUCF *accounts for* the features of the respective research areas. This does not mean that the framework is intended to supersede these research areas in the case of the insights, or to fix them, in the case of the limitations. Rather, it is a way of using the framework as a *lens* to view the existing research areas, which will allow a form of meta-insight about each area. In so doing, the goal is not to replace existing research but to appreciate and enhance it. This approach to appreciating, affirming, critiquing, and enhancing existing research areas using a Dooyeweerdian foundation is demonstrated by Joneidy & Basden (2013).

6.6.1 *Computer Procrastination and Psychology*

In order to analyse the literature on procrastination from the field of psychology, I chose a number of papers which are representative of this area of psychology. These included the paper by Lavoie & Pychyl (2001) which is the only extant example of research that specifically addresses the problem of computer and internet-related procrastination. Also included are an early seminal paper by Silver & Sabini (1981), and good-quality survey papers by Andreou (2007), Steel (2007) and van Eerde (2003). I read through these papers with careful attention to the central concepts, and classified these by the aspect (in the technical sense of Dooyeweerd's aspects; see Section 3.3) to which they are most closely related.[3] The following list of important concepts, arranged by aspect, was generated:

QUANTITATIVE "Hours spent using the internet" (Lavoie & Pychyl, 2001, p. 435)

SPATIAL "procrastination field" (Silver & Sabini, 1981, p. 215)

KINEMATIC "A click of a mouse button provides ready task avoidance" (Lavoie & Pychyl, 2001, p. 441)

PHYSICAL –

BIOTIC "stress, visits to health-care professionals" (van Eerde, 2003, p. 1411)

PSYCHIC/SENSITIVE "frustration" (Andreou, 2007, p. 183); "ephemeral pleasures" (Silver & Sabini, 1981, p. 214); "individual differences" (van Eerde, 2003, p. 1401); "task aversiveness" (van Eerde, 2003, p. 1410); "regret, apprehension, and guilt" (Lavoie & Pychyl, 2001, p. 434)

ANALYTICAL "necessarily irrational" (Andreou, 2007, p. 183); "discounting future utility" (Andreou, 2007, p. 185)

3 This is not to suggest that concepts are generally mono-aspectual – they almost never are. However, it is most often possible to determine one or a small number of aspects that are most central to a particular concept.

FORMATIVE "lack of impulse control" (van Eerde, 2003, p. 1402); "intended course of action" (Steel, 2007, p. 66); "achievement motivation", "self-regulatory failure" (Steel, 2007, p. 70)

LINGUAL "inaccurately expresses second-order desires" (Andreou, 2007, p. 185)

SOCIAL "image [reputation] of undependability" (van Eerde, 2003, p. 1402)

ECONOMIC "timing of rewards and punishments" (Steel, 2007, p. 68); "hyperbolic discounting" (Steel, 2007, p. 71)

AESTHETIC "the task is considered boring" (Steel, 2007, p. 82)

JURIDICAL "conscientiousness" (van Eerde, 2003, p. 1403)

ETHICAL "sympathetic environment" (Andreou, 2007, p. 190)

PISTIC "creative commitment devices" (Andreou, 2007, p. 190)

The next step in completing the *Human Use of Computers Framework Existing Research Analysis* is to distinguish between the various functionings that occur when the human uses the computer. (This distinction is represented by the horizontal component of the HUCF analysis table.) Because the psychology literature does not pay attention to the computer specific case of procrastination (with the exception of the Lavoie & Pychyl (2001) study), it is not surprising that virtually all of the insight from the field come under the heading of Human Living with Computers functioning. The one exception to this is the notion of "task aversiveness", which is a phrase describing the way in which the procrastinated task is unpleasant. Because the nature of the unpleasantness depends entirely on the particular task, this is one concept from the psychology literature which must look also at the *content* of the procrastinated and procrastinatory activities. This leads us to consider the SENSITIVE aspect of the EMC functioning, as the feeling of task aversion is not only experienced in human living (HLC category), but also in the engagement with the content itself as meaningful (EMC category).

We can gain some generic insights from psychology about what characteristics of tasks make them a greater procrastinatory temptation, when asking what it is in the nature of the computer experience that tends towards procrastination. For example, we can see that the ease of switching between applications allows computer-based distractions to be activities which are "brief or can be dropped at any moment" (Silver & Sabini, 1981, p. 214) or something which "requires a minimal commitment, doesn't take [the user] from the scene, and isn't immediately painful" (Silver & Sabini, 1981, p. 215). While it is both worthwhile and true to point out that it is the HCI functioning which enables this ease of switching, the sub-field of procrastination research in psychology doesn't much discuss this precisely because it is not a field which typically investigates computer use at all.

Thus, the vast majority of insight from the field is centred under the HLC aspect, with only brief reference in EMC to the psychic/sensitive aspect. Using the *HUCF Heatmap Visualization technique* (see Section 4.5.3) generates the heatmap shown in Figure 6.

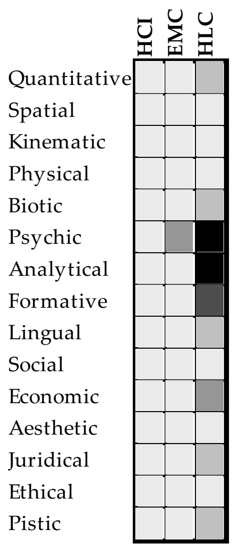

Figure 6: HUCF Analysis of Psychology

6.6.1.1 *How does the framework see this area?*

The PSYCHIC/SENSITIVE aspect of Dooyeweerd's suite of aspects largely corresponds to the study of psychology, although some parts of cognitive psychology also investigate ANALYTICAL functioning. As such, the framework can situate and contextualize the entire field of psychology. Although Dooyeweerd (1955–1958) considered the human self in its totality to be supra-theoretical, and thus not amenable to direct study, the nature of human behaviour in its psychological and analytical functioning is the proper study of psychology. Investigations into such topics as personality characteristics and individual differences are part of this PSYCHIC/SENSITIVE functioning.

The analysis and heatmap visualization shown above confirm that psychology is concerned with the PSYCHIC/SENSITIVE and ANALYTICAL aspects of procrastination, with some aspectual branching out to nearby aspects, particularly the FORMATIVE. The field of psychology doesn't directly address computer-specific procrastination, and so the areas of HCI and EMC are mostly ignored. One exception is that psychology can investigate the notion of "task aversiveness", which begins to move towards EMC functioning in the PSYCHIC/SENSITIVE aspect.

6.6.1.2 *How can the framework account for each insight in this area?*

INSIGHT: PSYCHOLOGY PREDICTS WHICH KINDS OF INDIVIDUALS ARE MORE LIKELY TO HAVE A PROCRASTINATION PROBLEM. The HUCF can account for this insight in two ways:

First, although procrastination research in psychology has mostly ignored the computer, the HUCF gives a prominent place to psychological research in a number of areas:

- how humans perceive and interact with symbolic communication from the computer (HCI - PSYCHIC/SENSITIVE aspect)
- understanding the feelings and perceptions required to interact with the content of a program (EMC - PSYCHIC/-SENSITIVE aspect)
- the nature of human personality and our propensity for procrastination. (HLC - PSYCHIC/SENSITIVE aspect)

Second, psychologists frequently discuss personality traits by referring to "The Big Five", a taxonomy of personality traits which identifies five stable factors of personality (Goldberg, 1993): *Openness, Extroversion, Conscientiousness, Agreeableness, and Neuroticism.* These traits have been shown to correlate with an extensive variety of human behaviour measurements (Soldz & Vaillant, 1999). A number of studies have shown links between various Big Five traits and procrastination, particularly in correlations with low conscientiousness and high neuroticism (Johnson & Bloom, 1995; Schouwenburg & Lay, 1995; van Eerde, 2003; Lay, Kovacs, & Danto, 1998). The use of Dooyeweerd's aspects within the framework allows us a way to incorporate insights about the kind of human functioning embodied by the Big Five traits. An aspectual analysis of these traits reveals a broad correspondence between each trait and one or more of Dooyeweerd's aspects (Breems, 2011):

Openness AESTHETIC (also PSYCHIC/SENSITIVE, ANALYTICAL and LINGUAL)

Conscientiousness FORMATIVE (also JURIDICAL, SOCIAL and ECONOMIC)

Extroversion PSYCHIC/SENSITIVE (also SOCIAL, LINGUAL and PHYSICAL)

Agreeableness ETHICAL (also PISTIC, SOCIAL, and PSYCHIC/SENSITIVE)

Neuroticism PSYCHIC/SENSITIVE (also ANALYTICAL and LINGUAL)

Thus, the framework can understand using its own language the insight from the field of psychology about which kinds of personality are more likely to be tempted by procrastination.

INSIGHT: PSYCHOLOGY CAN CONSIDER WHY SOME TASKS INTRODUCE A GREATER PROCRASTINATORY TENDENCY THAN OTHERS. The two main approaches to understanding why some tasks are more commonly procrastinated on, outlined in Section 6.4.2, are timing of rewards and punishments, which is primarily of the ECONOMIC aspect, and task aversiveness, which is primarily PSYCHIC/SENSITIVE. Again, we see that the comprehensive nature of the suite of Dooyeweerd's aspects allows us to account for and include a very wide range of research and insight into the problem of procrastination. Within the framework, each of these task characteristics is most relevant and meaningful in the HLC functioning. However, as the example framework analysis in 6.5 shows, the EMC category also has import; the PSYCHIC/SENSITIVE aspect of the procrastinatory activity, playing Yahtzee, was positive in EMC as compared to the negative PSYCHIC/SENSITIVE functioning of the blog writing in HLC.

6.6.1.3 *How can the framework account for the limitations in this area?*

LIMITATION: THERE IS A SURPRISING LACK OF RESEARCH SPECIFICALLY INTO PROCRASTINATION WITH COMPUTERS. The everyday orientation of the framework allows us to see that computer procrastination is a problem, and to take it seriously. It may be that the distinction between computer-related and non-computer-related procrastination is not a distinction that is psychologically interesting, but it does require psychological insight to understand. Thus, while the distinction between computer procrastination and non-computer procrastination has not captured the attention of the psychological research community, the HUCF can help us to see that it is an important problem that needs to be addressed.

The HUCF cannot, however, explain *why* the field of psychology has not found this an interesting problem and explicitly addressed the question of computer and internet procrastination. It is, in this sense, genuinely surprising. One of the contributing factors may be the difficulty of good experimental design: Determining the psychological difference between a computer-oriented task and a non-computer oriented task has become very difficult, because many tasks we perform on the computer no longer have a reasonable offline analogue.

LIMITATION: PSYCHOLOGY IS NOT ABLE TO EFFECTIVELY ASK QUESTIONS ABOUT NATURE OF TECHNOLOGY AND HUMAN INTERACTION. The nature of the technology (particularly in its LINGUAL and FORMATIVE aspects) is outside of the main interest of psychology in the PSYCHIC/SENSITIVE and ANALYTICAL aspects. Thus, the science of psychology is ill-equipped to reason about how particular technological choices and implementation may play into existing psychological tendencies. In addition, the categories of HCI and EMC functioning allow us to take seriously the nature of the technology at both the hardware and information levels.

6.6.2 *HCI*

Because the HCI field is large and multidisciplinary, it would be impossible to identify any small number of seminal papers, questionnaires, or other instruments to neatly characterize the field. Instead, I took a less formal approach, in which I scanned through the chapters of a common introductory textbook on HCI, Dix et al. (2004), under the in-person guidance of an experienced HCI researcher, Andrew Basden. Basden, in addition to being the developer of the HUCF, is also an HCI expert and professor who has been teaching HCI courses to undergraduates and post-graduates for a number of years. This results in a less rigorous analysis than several of the other, more easily characterizable, areas, and opens this analysis up to the possibility of greater researcher biases. In particular, the movement from the qualitative characterization of the meaning present in each aspect to the quantitative coding of the heatmap is even more subjective than for the other research areas. However, this is useful in that it demonstrates the flexibility of the framework to be adapted to a variety of research techniques, and at various levels of formality appropriate for the analysis.

QUANTITATIVE Miller's "Magical number 7 ± 2" (Miller, 1956; Kirschner, 2002); number of windows, buttons, etc.

SPATIAL Spatial layout on screen and keyboard

KINEMATIC Mouse movement; animation; gestures

PHYSICAL Input (keyboard/mouse) and output (pixels) are mostly physically assumed.

BIOTIC Organic aspect of I/O devices; repetitive strain injuries; User Interface (UI) hardware must fit the sensory-motor organs of the user

SENSITIVE Ergonomics; input/output channels; visual, aural, haptic channels; HCI is about how we perceive (mostly visually) the interface; HCI is interested insofar as users can only interact with the computer by perceiving and reacting

ANALYTICAL Recognizing and noticing user-interface objects; awareness of what is pertinent; attention; pattern recognition; speech recognition; HCI is interested insofar as interaction happens via distinct UI objects.

FORMATIVE User's tasks – Goals, Operators, Methods, and Selection rules (GOMS); The structure of the dialogue; Interaction styles – Command Line Interface (CLI) and Graphical User Interface (GUI); learning to use, gaining experience using; The structure and processing of interface objects – e.g. hypertext, Windows, Icons, Menus and Pointers (WIMP); locus of control (question and answer dialogue vs. free form interface, etc.); HCI is interested insofar as UI objects are structured and processed, and users achieve user interface activities.

LINGUAL Affordance (Norman, 1999); notations; User understands the meaning of the interface objects; HCI is interested insofar as it is important that the UI objects carry meaning in addition to just structure.

SOCIAL Sense of social convention of how to use the system; group working, collaborative work; see Carroll (2014) for emphasis on collaborative work.

ECONOMIC User economizes on motion, effort, time, cognitive capacity; Recognize the limitations of screen space, bandwidth, user attention.

AESTHETIC Harmony of user and technology; fun; eye candy; whimsicality; "look and feel"; elegance; screen colours; appreciating finishing touches, details

JURIDICAL Accessibility; notion of "what's due" is only implicit, not explicitly considered.

ETHICAL Loving the user is reduced to easy-to-use and pretty-to-look-at; generosity of the UI

PISTIC Implicit vision of who the user is; "holy wars" between user communities of competing applications e.g. vi vs. emacs

Unsurprisingly, all of the interest in the HCI field is concentrated in the HCI functioning, with no core areas expressing the meaning that occurs in the EMC or HLC functioning.

6.6.2.1 *How does the framework see this area?*

The insights of the HCI community in understanding human interaction are of vital importance to the HUCF, as evidenced by the fact that one of the three main categories of user functioning within the framework is HCI functioning. Thus, the framework not only fluidly incorporates much of the insight produced by the HCI research community, but also situates this insight into a larger context of computer use. That is, it can address how the user functions in his or her interaction with the interface, and it also shows how this functioning integrates with and supports the human functioning in terms of the content of the program (EMC) and in terms of the everyday life of the user (HLC).

The results of the HUCF analysis of the HCI field show that numerous aspects are important, with particular emphasis on the PSYCHIC/SENSITIVE (input/output channels, how we perceive the interface), the ANALYTICAL (how we distinguish the various user interface objects), the FORMATIVE (how we structure our tasks and the dialogue with the computer), and the LINGUAL (how the we understand the affordances of the interface, the notations, and the meaning of interface objects). We also note that some areas within HCI, notably the later aspects of JURIDICAL, ETHICAL, and PISTIC, are often overlooked.

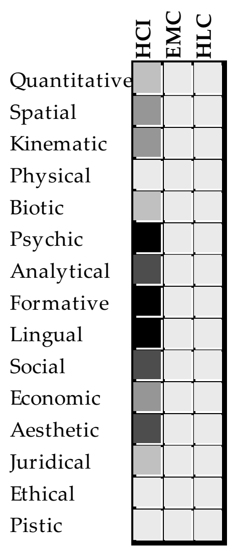

Figure 7: HUCF Analysis of the HCI research area

6.6.2.2 *How can the framework account for each insight in this area?*

INSIGHT: HCI RESEARCH CAN SITUATE PROCRASTINATION, AS A PARTICULAR KIND OF "USER INTERACTION", WITHIN A LARGER BODY OF WORK. Human-Computer Interaction is one of the three simultaneous human functionings in Basden's framework. Because of this, it can very naturally use the HCI community's insight to situate a various computer use situations within the larger research body. In this case, the framework sees the HCI of procrastination just like the HCI research community does.

INSIGHT: HCI RESEARCH IS CONCERNED WITH UNDERSTANDING ATTENTION AND THE COGNITIVE AND AFFECTIVE STATE OF THE USER DURING COMPUTER USE. In terms of the HUCF's aspects:

- Affective state is primarily PSYCHIC/SENSITIVE
- Cognitive state is ANALYTICAL
- Attention is both ANALYTICAL (determining what to focus on) and FORMATIVE (shaping our world through the selective application of our attention).

6.6.2.3 *How can the framework account for the limitations in this area?*

LIMITATION: SURPRISINGLY, NO RESEARCH DIRECTLY INTO PROCRASTINATION HAS BEEN DONE FROM WITHIN THE HCI COMMUNITY. Research in HCI, concentrating on the interaction with the machine, often overlooks issues involving content or everyday life. In terms of the framework, it concentrates on HCI to the exclusion of EMC and HLC functioning. It thus has a blind spot, and does not see an everyday life problem like procrastination as something within its field.

(This, however, belies the fact that this area is nominally interested in psychological and social effects of computer use, as evidenced by the aims and scope of a leading HCI journal, "Human Computer Interaction" (Human Computer Interaction, 2014).) Thus while computer procrastination is, by the definition given in Section 6.2.2, a problem that only arises during human-computer interaction, the HCI community has not viewed it as a problem within their domain of interest.

The framework can help here, by guiding research attention towards the larger life issues that arise out of our interaction with the machine. That is, the framework pushes us to investigate the EMC and HLC functionings whenever we're considering HCI functioning. The three functionings do not exist independently. They are not only simultaneous, they are mutually interdependent.

The relationships between HCI, EMC, and HLC is complex. From the HCI perspective, it is HCI functioning that enables the following functionings to exist. Norman has described this as *perceived affordance* (Norman, 1999), modifying Gibson's original proposal of affordance from 1977 (Greeno, 1994) with the observation that in interface design, only affordance which is perceived by the user is meaningful. In HCI, the components which compose the interface both suggest and allow for interaction with the meaningful content of the program. Thus, affordance can be thought of as the way HCI views its end of the HCI-EMC relationship.

Using this insight, the framework suggests that one way for the HCI community to approach the problem of procrastination would be to examine which properties (affordances) of the interface allow and invite the procrastination to take place, and then to explore design alternatives which would not expose such affordances.

LIMITATION: HCI HAS LOWER LEVEL CONCERNS THAN PROCRASTINATION. Aspectually speaking, HCI concentrates on:

- PSYCHIC/SENSITIVE aspect – perceiving output
- ANALYTIC aspect – of distinguishing (on screen, etc...)
- FORMATIVE aspect – of structure of our tasks, and of the interface objects
- LINGUAL aspect – of symbolically represented content on screen

But procrastination is most centrally meaningful in:

- PSYCHIC/SENSITIVE aspect – aversive feelings from original task
- ECONOMIC aspect – waste of time
- AESTHETIC aspect – boring vs. fun and engaging
- JURIDICAL aspect – inappropriateness of time use; not giving tasks their due
- PISTIC aspect – commitment, self-deception

It is thus not as surprising as it might first appear that the HCI research field is silent on the problem of computer procrastination. Even when the concerns of the HCI research community are broadened to include HLC functioning where procrastination takes place, the aspects most frequently of interest to HCI researchers don't find the problem of procrastination meaningful or interesting. By extending the attention of the HCI community to everyday problems that occur in the later aspects such as AESTHETIC, JURIDICAL, and PISTIC, the use of a comprehensive suite of aspects can help the HCI field overcome this limitation.

6.6.3 *Technology Acceptance Model*

Because TAM is a more contained research area than large fields like psychology or HCI, it is possible to analyse TAM by referring to standard measurement instruments for the TAM model, using the original scale provided by Davis (1989), and an updated inventory suggested by Venkatesh et al. (2003).

The items used in the TAM inventory (Davis, 1989) are analysed in Table 12.

Table 13 analyses the Unified Theory of Acceptance and Use of Technology (ITAUT) inventory (Venkatesh et al., 2003).

With these analyses complete, a heatmap can be created, shown in Figure 8, by assigning a value to each aspectual category (as discussed in Section 4.5.3). The resulting diagram can help to intuitively understand why TAM is unable to effectively address computer procrastination.

6.6.3.1 *How does the framework see this area?*

The two central concepts of TAM, Perceived Usefulness (PU) and Perceived Ease Of Use (PEOU) fit well within the HUCF.

First, *Perceived Ease Of Use*, defined by Davis (1989) as "the degree to which a person believes that using a particular system would be free of effort" (p. 320), has many parallels with the HCI category of the HUCF. Proper HCI functioning will almost inevitably make the application easy-to-use, although HCI is a richer category of functioning than only ease-of-use.

Second, the *Perceived Usefulness* category in TAM, originally defined by Davis (1989) as "the degree to which a person believes that using a particular system would enhance his or her job performance" (p. 320), can be effectively addressed with the HLC functioning in the HUCF. That is, the user in this case is concentrating on the everyday human effects that the information system will have in their lives.

The results of the aspectual analysis of the concerns in TAM are shown in Figure 8. The analysis reveals that TAM's interest in HCI focuses most heavily on the ANALYTICAL, FORMATIVE, LINGUAL, and ECONOMIC aspects, as the ease-of-use definition given

Measurement Item	HUCF Classification	Key Words for Aspectual Classification
My job would be difficult to perform without [the system].	Formative HLC	difficult, perform
Using [the system] gives me greater control over my work.	Formative HLC	control
Using [the system] improves my job performance.	Analytical HLC; Formative HLC	improves, performance
[The system] addresses my job-related needs.	Lingual HLC	addresses
Using [the system] saves me time.	Economic HLC	saves
[The system] enables me to accomplish tasks more quickly.	Formative HLC, Economic HLC	accomplish, quickly
[The system] supports critical aspects of my job.	Analytical HLC	critical
Using [the system] allows me to accomplish more work than would otherwise be possible.	Analytical HLC	otherwise possible
Using [the system] reduces the time I spend on unproductive activities.	Economic HLC	unproductive
Using [the system] enhances my effectiveness on the job.	Formative HLC	enhances, effectiveness
Using [the system] improves the quality of the work I do.	Juridical HLC	quality
Using [the system] increases my productivity.	Economic HLC	productivity
Using [the system] makes it easier to do my job.	Formative HLC	easier
Overall, I find [the system] useful in my job.	Formative HLC	useful, job
I often become confused when I use [the system].	Lingual HCI	confused
I make errors frequently when using [the system].	Analytical HCI, Juridical HLC	frequently, errors
Interacting with [the system] is often frustrating.	Aesthetic HCI, Aesthetic HLC	frustrating
I need to consult the user manual often when using [the system].	Lingual HCI	consult, manual
Interacting with [the system] requires a lot of my mental effort.	Analytical HCI, Formative HCI	mental, effort
I find it easy to recover from errors encountered when using [the system].	Juridical HCI	errors
[The system] is rigid and inflexible to interact with.	Analytical HCI, Formative HLC	rigid, inflexible, interact
I find it easy to get [the system] to do what I want it to do.	Formative HCI	easy
[The system] often behaves in unexpected ways.	Analytical HCI	unexpected
I find it cumbersome to use [the system].	Aesthetic HCI	cumbersome
My interaction with [the system] is easy for me to understand.	Lingual HCI	understand
It is easy for me to remember how to perform tasks using [the system].	Analytical HCI	remember
[The system] provides helpful guidance in performing tasks.	Ethical HCI, Lingual HCI	helpful, guidance
Overall, I find [the system] easy to use.	Analytical HCI, Formative HCI	find, easy

Table 12: Aspectual analysis of the TAM inventory

MEASUREMENT ITEM	CLASSIFICATION	KEY WORDS FOR ASPECTUAL CLASSIFICATION
I would find the system useful in my job.	Analytical HLC, Formative HLC	find, useful
Using the system enables me to accomplish tasks more quickly.	Economic HLC	quickly
Using the system increases my productivity.	Economic HLC	productivity
If I use the system, I will increase my chances of getting a raise.	Economic HLC, Analytical HLC	raise, increase chances
My interaction with the system would be clear and understandable.	Lingual HCI	clear, understandable
It would be easy for me to become skillful at using the system.	Formative HCI	skillful
I would find the system easy to use.	Analytical HCI, Formative HCI	find, easy
Learning to operate the system is easy for me.	Analytical HCI, Formative HCI	learning, operate
Using the system is a bad/good idea.	Juridical HLC	good/bad
The system makes work more interesting.	Aesthetic HLC	interesting
Working with the system is fun.	Aesthetic HCI	fun
I like working with the system.	Sensitive HCI	like
People who influence my behaviour think that I should use the system.	Social HLC	people, influence
People who are important to me think that I should use the system.	Social HLC, Analytical HLC	people, think
The senior management of this business has been helpful in the use of the system.	Formative HLC, Economic HLC, Ethical HLC, Formative HCI	management, business, helpful, use
In general, the organization has supported the use of the system.	Social HLC, Formative HLC	organization, supported
I have the resources necessary to use the system.	Economic HLC, Formative HCI	resources, use
I have the knowledge necessary to use the system.	Analytical HLC, Formative HCI	knowledge, use
The system is not compatible with other systems I use.	Lingual HCI	compatible
A specific person (or group) is available for assistance with system difficulties.	Ethical HLC, Formative HCI	available, difficulties
I could complete a job or task using the system if there was no one around to tell me what to do as I go.	Formative HCI, Social HLC, Lingual HLC	complete, no one around, tell me
I could complete a job or task using the system if I could call someone for help if I got stuck.	Formative HCI, Lingual HLC	complete, call
I could complete a job or task using the system if I had a lot of time to complete the job for which the software was provided.	Formative HCI, Economic HCI	complete, lot of time

Table 13: Apsectual Analysis of the ITAUT Inventory

Measurement Item	Classification	Key Words for Aspectual Classification
I could complete a job or task using the system if I had just the built-in help facility for assistance.	Formative HCI, Ethical HCI	complete, help
I feel apprehensive about using the system.	Sensitive HLC	feel apprehensive
It scares me to think that I could lose a lot of information using the system by hitting the wrong key.	Sensitive HCI, Juridical HCI, Lingual ERM;	scares, lose, information
I hesitate to use the system for fear of making mistakes I cannot correct.	Formative HCI, Sensitive HCI, Analytical ERM;	hesitate, fear, mistake
The system is somewhat intimidating to me.	Sensitive HLC	intimidating
I intend to use the system in the next <n> months.	Formative HLC	intend
I predict I would use the system in the next <n> months.	Formative HLC	predict
I plan to use the system in the next <n> months.	Formative HLC	plan

Table 13: Apsectual Analysis of the ITAUT Inventory (cont.)

by Davis depends most heavily on these aspects. In determining whether or not the system is useful, tam uses the HLC aspects of analytical (determining if the system helps with performance), formative (structuring or shaping the work environment), social (appeal to social norms of other co-workers using it), and economic (saving time and effort).

6.6.3.2 *How can the framework account for each insight in this area?*

insight: TAM provides good predictive power for determining which kinds of technology are likely to be accepted and used. The significant overlap between the tam categories of ease-of-use and usefulness and the HUCF functionings of HCI and HLC allows the HUCF to incorporate the predictive abilities of the TAM model. Indeed, use of the aspects can be helpful in opening up the "black box" of usefulness, allowing us to reason about what makes the system seem, and be, useful (Joneidy & Basden, 2011).

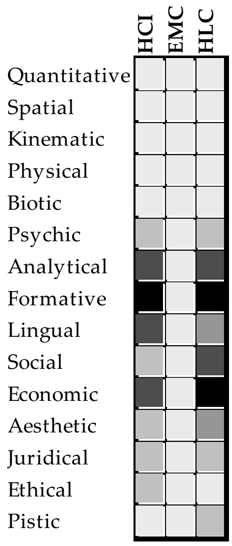

Figure 8: HUCF Analysis of TAM

6.6.3.3 *How can the framework account for the limitations in this area?*

Limitation: TAM research doesn't directly address the actual issue of procrastination. Because TAM focuses on a single application or a small group of applications which make up an information system, it is unable to investigate the everyday use of a computer system as a whole. Because procrastination typically becomes an issue when the user invokes applications beyond the information system under consideration, TAM misses it; without a "whole computer, whole life" orientation, problems like procrastination don't come into focus. The HUCF provides this.

Limitation: TAM is strictly restricted to the notion of perceptions of performance, and only in the workplace. Because TAM investigates only perceived usefulness, it potentially misses a problem like use of a computer for procrastination, which occurs despite the user perceiving its negative utility ahead of time. Thus, to predict whether or not a computer system will be used for procrastinatory purposes, we need a framework which investigates how useful a system actually is (both in terms of completing the original task and in terms of meeting the user's short-term PSYCHIC/SENSITIVE needs) apart from the user's perceptions.

In addition, the everyday orientation of the HUCF allows us to address computer use situations outside of the workplace.

LIMITATION: IT DOES NOT PROVIDE NORMATIVE GUIDANCE FOR QUESTIONS OF WHETHER ADOPTION AND USE OF AN INFORMATION SYSTEM IS A SUITABLE GOAL. TAM makes no claim about normativity of IS use. From TAM's point of view, the appropriateness of using a given software product must be determined before the TAM model is applied. However, the normative basis of the HUCF helps us see that to consider a problem like procrastination, normativity cannot be a prior question. An information system that tempts towards procrastination must be normatively evaluated both before and during use, and TAM does not provide tools for doing so, while the HUCF does.

LIMITATION: TAM'S ASSUMPTION THAT INTENTION WILL LEAD TO BEHAVIOUR IS VIOLATED IN THE CASE OF PROCRASTINATION. The everyday orientation of the HUCF allows us to consider the deeply multi-causal phenomenon of human action without attempting to reduce it to a single theoretical model, as the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975), the Theory of Blanned Behaviour (TPB) (Ajzen, 1991), and the Technology Acceptance Model (Davis, 1989) all implicitly do. By recognizing that intentions do matter, but that they are not the only deciding factor in any particular situation, we can apply the insights that TAM brings to bear, while simultaneously recognizing that in the case of procrastination, other insights about how human behaviour results are also needed.

6.6.4 *Non-Work-Related Internet Use*

Similar to the approach taken with Psychology in Section 6.6.1, in this field it worked well to choose a handful of seminal papers for aspectual analysis. In this case, these included Lim (2002), Woon & Pee (2004), Blanchard & Henle (2008) and Garrett & Danziger (2008), which resulted in the following analysis:

QUANTITATIVE –

SPATIAL

- "Cyberloafers need not be absent from the office for inexplicably long periods of time" (Lim, 2002, p. 678) [both HCI and HLC]

KINEMATIC –

PHYSICAL –

BIOTIC –

SENSITIVE

- "personal Internet use as an attempt to alleviate this disaffection" (Garrett & Danziger, 2008, 938) [HLC]
- "employees who are emotionally attached to their work organization will find personal Internet use to be less compatible" (Garrett & Danziger, 2008, p. 941) [HLC]

ANALYTICAL

- "A couple of seconds is no big deal in the greater scheme of things." (Garrett & Danziger, 2008, p. 939) [EMC]
- "very favourable evaluation of how he or she has utilized the technology in the past" (Garrett & Danziger, 2008, p. 940) [HLC]
- "each act is perceived as having potential outcomes that have positive or negative value, together with a probability that the outcome will occur." (Woon & Pee, 2004, p. 81) [HLC]

FORMATIVE

- "Looking up a work-related news story easily leads to checking the baseball standings or a movie review." (Garrett & Danziger, 2008, p. 939) [EMC]
- "external locus of control (extent to which individuals believe they have control over a situation)", (Blanchard & Henle, 2008, p. 1071) [HLC]
- "Routinization." (Garrett & Danziger, 2008, p. 941) [HLC]
- "facilitating conditions as objective factors in the environment that several judges or observers can agree make a behaviour easy to perform." (Woon & Pee, 2004, p. 81) [HLC]

LINGUAL

- "Email, chat applications" (Blanchard & Henle, 2008, p. 1076) [EMC]
- "visiting a news website" (Blanchard & Henle, 2008, p. 1082) [EMC]
- "maintaining the guise [symbolic signification] of being hard at work in the real world while in effect, travelling through cyberspace" (Lim, 2002, p. 678) [HLC]

SOCIAL

- "norms of acceptable behaviour" (Blanchard & Henle, 2008, p. 1071) [HLC]
- "social influence from co-workers and supervisors was related to frequency of and time spent cyberloafing." (Blanchard & Henle, 2008, p. 1071) [HLC]

ECONOMIC

- "lost wages through decreased productivity" (Blanchard & Henle, 2008, p. 1068) [HLC]
- "clogs bandwidth and degrades system performance" (Blanchard & Henle, 2008, p. 1068) [HLC]

AESTHETIC

- "can lead to creativity, flexibility, camaraderie, and foster a learning environment" (Blanchard & Henle, 2008, p. 1069) [HLC]
- "Job satisfaction." (Garrett & Danziger, 2008, p. 944) [HLC]
- "Alleviation of boredom." (Garrett & Danziger, 2008, p. 950) [HLC]
- "Affect refers to individual's pure emotion of joy, elation, pleasure, depression, distaste, discontentment, or hatred with respect to a particular behaviour." (Woon & Pee, 2004, p. 81) [HLC]

JURIDICAL

- "personal email and Internet use at work can be appropriate if certain conditions are met."(Blanchard & Henle, 2008, p. 1080) [EMC]
- "If the employee engages in illegal activities online" (Blanchard & Henle, 2008, p. 1068) [HLC]
- "justify their cyberloafing practices because 'everybody else does it."' (Blanchard & Henle, 2008, p. 1071) [HLC]
- "perceived injustice at work provokes such behaviour" (Garrett & Danziger, 2008, p. 939) [HLC]

ETHICAL

- "creates a harassing environment through viewing or sending offensive material" (Blanchard & Henle, 2008, p. 1068)

PISTIC

- "external locus of control (extent to which individuals believe they have control over a situation)" (Blanchard & Henle, 2008, p. 1071) [HLC]
- "feelings of mistrust between management and employees" (Blanchard & Henle, 2008, p. 1080) [HLC]

- "job commitment" (Garrett & Danziger, 2008, p. 941) [HLC]
- "non-work-related activity is inconsistent with self-image" (Garrett & Danziger, 2008, p. 941) [HLC]

This analysis is visualized in the heatmap in Figure 9.

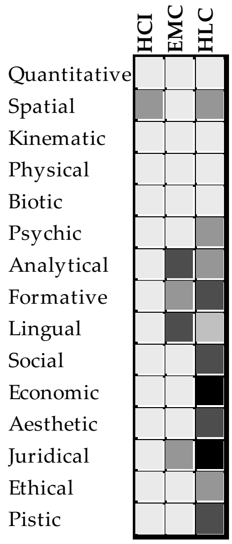

Figure 9: HUCF Analysis of Non-work-related Internet Use research

6.6.4.1 *How does the framework see this area?*

Research into non-work-related internet use proposes a variety of explanations:

- Blanchard & Henle (2008) attempt to explain NWRIU in terms of the perceived norms of co-workers and external locus of control.
- Garrett & Danziger (2008) point out the explanatory power of workplace disaffection and expected outcome.
- Lim (2002) explained cyberloafing in terms of perceived organizational injustice.

The use of aspects in the framework can help us understand and categorize the current research:

- Perceived norms of co-workers (SOCIAL aspect)

- External locus of control (multi-aspectual, but with emphasis in the PISTIC and FORMATIVE aspects)
- Workplace disaffection (PSYCHIC/SENSITIVE and JURIDICAL aspect)
- Expected outcome (ANALYTICAL and ECONOMIC aspect).
- Perceived organizational injustice (JURIDICAL aspect).

In addition to these, the ability to distinguish the type of content being used, and to make judgements about whether that content is legitimately work-related or otherwise acceptable relies on ANALYTICAL and JURIDICAL functioning in HLC. The centrality of the ECONOMIC impact of such use, and the JURIDICAL importance of giving both the employee and employer their due are highlighted as well. The AESTHETIC aspect plays a role in terms of job satisfaction (Garrett & Danziger, 2008). The JURIDICAL, in addition to its role in Lim's (2002) explanation in terms of perceived injustice, also comes into the justifications employees use to excuse their behaviour (Blanchard & Henle, 2008). PISTIC functioning is important when thinking about "mistrust between management and employees" (Blanchard & Henle, 2008, p. 1080) and job commitment (Garrett & Danziger, 2008).

EMC functioning becomes important when discussing the characteristics of applications most frequently used for NWRIU. For example, a common type of cyberslacking is personal email, or use of chat programs, both of which are centrally LINGUAL in nature. The FORMATIVE structure of a hypertext document invites distraction as well, as starting from a legitimate web page and clicking the links that are interesting can quickly bring the employee to non-work-related content.

Finally, the SPATIAL nature of the computer means that "cyberloafers need not be absent from the office for inexplicably long periods of time" (Lim, 2002, p. 678), a key facilitating factor that is part of the basic HCI functioning in the modern office.

The wide diversity of aspects represented in the literature can be a good sign. It is an implicit recognition of the complexity and richness of the phenomenon, and leads to the insight that narrow approaches are unlikely to solve it. Alternately, in the case of NWRIU the wide variety of aspectual approaches may also stem from the relative youth of this field of research; it has not yet settled on a unified vision of how to frame the problem. Unfortunately, attempts at unification will often centre around a either one or two aspects, and try to explain all of the diversity of meaningfulness in terms of those aspects. For example, in Lim's (2002) early research into the area, she explains the difficulty almost entirely through the JURIDICAL lens of perceived organizational injustice and neutralization techniques the employee may invoke in an attempt to "restore [fairness and] balance to the employment relationship" (p. 680).

Because of the complex and multi-aspectual nature of this human behaviour, attempts to reduce explanations to use a single aspect will always result in loss of meaning and nuance. Garrett & Danziger (2008), for example, recognize this and demonstrate a nuanced approach that is sensitive to the inherent diversity of meaning in reality, by emphasizing that their explanation in terms of expected outcome should be seen as "complementary and reinforcing" of other explanations rather than in competition with them (p. 938).

By using Dooyeweerd's comprehensive, non-reductionist list of aspects, the HUCF can provide a richer story, accounting for greater diversity of meaning. As a young field in search of a unifying vision, Non-Work-Related Internet Use could benefit from the insight available through Basden's HUCF.

6.6.4.2 *How can the framework account for each insight in this area?*

INSIGHT: RESEARCH ON NON-WORK-RELATED INTERNET USE DEMONSTRATES THE DOUBLE-SIDED EFFECTS OF WORK-

PLACE INFORMATION TECHNOLOGY. Each of Dooyeweerd's aspects corresponds to different norms, and thus to different types of repercussions. As such, the use of Basden's HUCF allows us to not only accept, but to expect that the use of any given technology will have a variety of kinds of effects, some of which may be desirable and others negative (Basden, 2008, p. 77). Further, by analysing where the non-normative activity is occurring, the framework can guide us towards understanding and addressing the problems.

INSIGHT: THIS RESEARCH REVEALS HOW EXTENSIVE THE PROBLEM CAN BE. In addition to recognizing the diversity of repercussions, the everyday orientation of the framework also allows us to understand connections between different parts of the problem. For example, realizing that there is a PISTIC failure of commitment on the part of an employee is insightful, but the insight doesn't become practical until our attention is also drawn to, for example, the ECONOMIC aspect (lost productivity), the PSYCHIC/SENSITIVE aspect (feelings of angst, frustration, or boredom at work), or the QUANTITATIVE aspect (how many employees, how much time spent, etc.). Thus the framework can recognize how multi-aspectual problems can have causes in some aspects and manifest extensive symptoms in other aspects.

INSIGHT: THIS RESEARCH CAN SHOW NUMEROUS ANTECEDENTS THAT ARE ASSOCIATED WITH NON-WORK-RELATED INTERNET USE. As mentioned above, the numerous antecedents that research has found to correlate with NWRIU occur in a wide variety of aspects of meaning. The framework is ideally suited for situating these varied antecedents.

6.6.4.3 *How can the framework account for the limitations in this area?*

LIMITATION: THE RESEARCH IS ABOUT ONLY THE WORKPLACE; IT DOES NOT CONSIDER "EVERYDAY" USE AT HOME OR SCHOOL. Because this research originates in the field of management and organizational behaviour, it often views the issues, at least originally, through the narrow lens of the ECONOMIC aspect. While there is certainly need to understand the unique computer use situations and problems that occur in the workplace, the multi-aspectual approach of the framework can help us think about substantially similar issues (wasting time online when there are important tasks to be accomplished) which occur in other settings.

LIMITATION: IT IS FOCUSED EXCLUSIVELY ON BEHAVIOUR THAT IS INTENTIONAL AND VOLUNTARY; IT IGNORES THE SITUATION OF EMPLOYEES WHO WANT TO BE PRODUCTIVE AT WORK, BUT FIND THEMSELVES DISTRACTED AND PROCRASTINATING. While there is significant debate (and historic paradigm shifts from one pole to the other) regarding the nature of agency and determinism within psychology in general (Sappington, 1990; Bandura, 1989; Baer, Kaufman, & Baumeister, 2008), the NWRIU field of research appears to implicitly accept that every action of the employee is under their direct, conscious, voluntary control. For example, Garrett & Danziger (2008) discuss various explanations for "the individual's *decision* to engage in personal online activities at work" (p. 949, emphasis added).

The multifarious nature of the framework allows us to accept that the various aspects of human functioning involve different degrees and kinds of volitional involvement. For example:

- Functioning at the BIOTIC level involves almost no direct, conscious input from the employee.

- SOCIAL activity involves give-and-take between the employee's motivations and the externally-imposed social environment and norms.
- At the ETHICAL level, the nature of self-giving is almost entirely voluntary (though still affected by habit and cultural norms).

The notion of *voluntary* action is multi-aspectual, but comes most to the fore in the FORMATIVE aspect, which centres around human shaping, planning, and creating. The assumption of voluntary action within the NWRIU research community may indicate an over-emphasis of the FORMATIVE aspect resulting in neglect of other aspects that also hold some explanatory power.

LIMITATION: NON-WORK-RELATED INTERNET USE RESEARCH RELIES ON THE NOTION OF INAPPROPRIATE WORKPLACE USAGE, BUT PROVIDES NO NORMATIVE BASIS FOR JUDGING APPROPRIATENESS. Much of the research on non-work-related internet use relies on a notion of which internet activities are appropriate for the workplace and in what ways they may be inappropriate (Blanchard & Henle, 2008). This way of thinking about production deviance, however, requires us to have criteria for judging which activities are appropriate and which are not. While Blanchard and Henle appeal to social norms in making this decision, in some cases the social norms in an organization may be in direct conflict with the economic expectations of the employers. The NWRIU research area does not provide a basis for examining these competing notions of appropriate.

Use of the framework addresses this difficulty, because each of the aspects has laws and norms associated with it. By taking into consideration the full diversity of meaning in human functioning, the framework can help us avoid the fragmentation of human life by recognizing that the employees continue to be multi-aspectually functioning people even in the workplace. The needs of family, friends, faith, leisure or health do not end at the office door. Recognizing some (limited) place at the office for the expression of these aspects of the employee's personhood is not only normative in those aspects, it will, in most cases, result in happier, more productive employees and thus be in the employer's economic interest as well. The use of the framework also enables us to take seriously the legitimate concerns of the employer regarding wasted time without sacrificing the authentic personhood of the employee and the employer's legitimate claim to some control over how the employees spend their time at the office.

6.6.5 *Problematic Internet Use*

Researchers in the area of Problematic Internet Use have used a couple of diagnostic tests for differentiating when a person is suffering from compulsions to use the internet:

- The Internet Addiction Diagnostic Questionnaire (IADQ) was developed by Young (1998), and modified and explained more fully in a chapter of her edited book (Young, 2011). The questionnaire consists of 8 yes/no questions, asking the user about:
    - Preoccupation with the internet
    - amount of time needed to satisfy their need
    - efforts to cut back
    - withdrawal symptoms
    - time spent
    - life goals jeopardized
    - hiding the behaviour
    - escaping other problems online

  If the user responds affirmatively to numerous questions, internet addiction (problematic internet use) is indicated.
- A more robust and psychometrically-validated Internet Addiction Test (IAT) was proposed by Widyanto & McMurran (2004). It consists of 20 questions answered on a five

point Likert scale (from "Rarely" to "Always"), and includes concepts such as staying online longer than intended, neglecting other duties, lost sleep, etc.

In addition to these diagnostic tests, a number of important papers and book chapters were also included in the existing research analysis. These selected titles help to fill out the range of aspects considered by this field. They include: Caplan & High (2011), Greenfield (2011), Blinka & Smahel (2011), Widyanto & McMurran (2004), Young (2011), Young & de Abreu (2011), and Young, Yue, & Ying (2011).

QUANTITATIVE

- "How often do you find yourself saying 'just a few more minutes' when online?" (IAT) [HLC];
- Percent of population affected (Young et al., 2011, p. 4) [HLC];

SPATIAL –

KINEMATIC –

PHYSICAL

- "studies have suggested that neurochemical processes play a role in all addiction" (Young et al., 2011, p. 10) [HLC]

BIOTIC

- "How often do you lose sleep due to late night log-ins?" (IAT) [HLC];
- Sexual compulsions, internet pornography (Young & de Abreu, 2011, p. 113) [EMC];
- "Increasing risk of poor diet and exercise" (Young, 2011, p. 20) [HLC]

SENSITIVE

- "Do you feel restless, moody, depressed, or irritable when attempting to cut down or stop Internet use?" (IADQ) [HLC]

- “Do you use the Internet as a way of escaping from problems or of relieving a dysphoric mood (e.g., feelings of helplessness, guilt, anxiety, depression)?” (IADQ) [HLC]
- “How often do you feel depressed, moody, or nervous when you are offline, which goes away once you are back online?” (IAT) [HLC]
- “Anonymity and lack of face-to-face communication online may decrease self-consciousness and social anxiety” (Caplan & High, 2011, p. 45) [HCI]
- “increased loneliness and depression” (Young et al., 2011, p. 12)[HLC]
- “The Internet can become a psychological escape that distracts a user from a real-life problem or difficult situation” (Young et al., 2011, p. 13) [HLC]

ANALYTICAL

- “Do you feel preoccupied with the Internet?” (IADQ) [HLC]
- “maladaptive cognitions such as overgeneralising or catastrophising and negative core beliefs” (Young et al., 2011, p. 8) [HLC]

FORMATIVE

- “Have you repeatedly made unsuccessful efforts to control, cut back, or stop Internet use?” (IADQ) [HLC]
- “How often do you try to cut down the amount of time you spend online and fail?” (IAT) [HLC]
- “delay other work to spend time online” (Young et al., 2011, p. 5) [HLC]
- “abstinence from problematic applications while retaining controlled use of the computer for legitimate purposes” (Young et al., 2011, p. 7)[HLC]

LINGUAL

- “Have you lied to family members or therapists to conceal the extent of your internet use?” (IADQ) [HLC]
- “Online chat rooms” (Widyanto & McMurran, 2004, p. 444) [EMC]
- “non-dependent Internet users spent most of their time online using e-mail and surfing web sites, dependent users spent most of their time online using synchronous interpersonal communication applications” (Caplan & High, 2011, p. 37) [EMC]
- “only real time communication functions, that is, instant messaging and chatting, had higher incidences of compulsive Internet use 6 months later” (Caplan & High, 2011, p. 37) [EMC]
- “Due to the unique communication context of the Internet ... ... demonstrates a preference for virtual, rather than face-to-face, interpersonal communication” (Young et al., 2011, p. 7, quoting Davis et al., 2002) [HLC]
- “increased use of the Internet was associated with decreased family communication” (Young et al., 2011, p. 12) [HLC]

social

- “How often do you form new relationships with others online?” (IAT) [HLC]
- “Slower rate of social information exchange” (Caplan & High, 2011, p. 43) [HCI]
- Facebook friends, online community (Greenfield, 2011, p. 146) [EMC]
- “attracted to the unique social experiences available online.” (Caplan & High, 2011, p. 37) [EMC]
- “study found higher levels of loneliness among ... pathological or addicted users of the Internet” (Young et al., 2011, p. 11) [HLC]

- Anonymity (Caplan & High, 2011, p. 36) [HLC]
- "answer a deep and compelling need in people whose real lives are interpersonally impoverished and devoid of intimacy" (Young et al., 2011, p. 12) [HLC]
- "increased use of the Internet was associated with ... reduced size of the local social circle" (Young et al., 2011, p. 12) [HLC]
- "warning signs can often be masked by cultural norms that encourage and reinforce online use" (Young, 2011, p. 21) [HLC]

economic

- "How often does your job performance or productivity suffer because of the internet?" (IAT) [HLC]
- "generally excessive about their online usage, spending anywhere from 40 to 80 hours per week" (Young, 2011, p. 20) [HLC]

aesthetic

- "How often do you fear that life without the Internet would be boring, empty, and joyless?" (IAT) [HLC]
- "Do you prefer the excitement of the internet over intimacy with your partner?" (IAT) [HLC]
- Games (Widyanto & McMurran, 2004, p. 448), (Blinka & Smahel, 2011, p. 73) [EMC]
- "Feel life would be boring without the Internet" (Young et al., 2011, p. 5) (HLC)

juridical

- "Have you lied to family members, therapists, or others to conceal the extent of involvement with the Internet?" (IADQ) [HLC]
- "How often do you neglect household chores to spend more time online?" (IAT) [HLC]

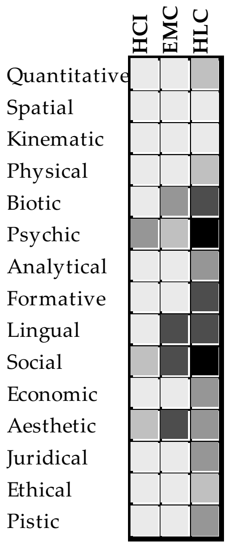

Figure 10: HUCF Analysis of Problematic Internet Use Research

- "[some] use of the internet is legitimate in business and home practices." (Young, 2011, p. 24) [HLC]

ETHICAL

- "Do others in your life complain to you that you spend too much time online?" (IAT) [HLC]

PISTIC

- "has led many young people to look for 'spiritual compensation' from the online activities" (Young et al., 2011, p. 11) [HLC]
- "Internet as a means to compensate or cope with deficits in self-esteem, identity" (Young et al., 2011, p. 11) [HLC]

This analysis is visualized in the heatmap in Figure 10.

6.6.5.1 *How does the framework see this area?*

With its emphasis on the effects of the problem in the user's everyday life, this area is heavily focused on the HLC functioning. In particular, the PSYCHIC/SENSITIVE functioning in HLC is strongly represented because the problem results from using the internet to avoid unpleasant feelings and emotions in other areas of life (Young et al., 2011; Widyanto & McMurran, 2004, p. 13) and SOCIAL functioning in HLC because of impoverished real-life relationships (Young et al., 2011, p. 12) as both antecedent and consequence, and increased online relationships. The FORMATIVE aspect also plays a role, as the user no longer has the ability to shape or control the role the internet plays in their life (Young, 1998).

The EMC and HCI functionings also play a role, albeit a lesser one. In EMC, the aspectual profile depends on the precise nature of the application which is problematic: Chat programs and email (LINGUAL aspect), social networking (SOCIAL aspect) and game playing (AESTHETIC aspect) are all common forms which internet addiction can take (Caplan & High, 2011; LaRose, 2011). HCI functioning is where the nature of the computer technology itself is most concrete, and so factors such as the anonymity and lack of face-to-face communication (Caplan & High, 2011, p. 45) can be placed in the SENSITIVE and SOCIAL aspects of this functioning.

6.6.5.2 *How can the framework account for each insight in this area?*

INSIGHT: PIU RESEARCH IS CLINICALLY USEFUL FOR HELPING THOSE WITH SEVERE LIFE DYSFUNCTION DUE TO COMPUTER AND INTERNET USE. The BIOTIC aspect, with its norms of health and flourishing, provides a helpful way to understand the goals of this research field. In particular, it points to the distinction that we can make between the obvious and troubling symptoms of life disruption for those who suffer under this condition from the more general case of procrastination that afflicts many otherwise healthy adults. In this context, the framework can see that the BIOTIC and PSYCHIC/SENSITIVE aspects in the HLC functioning are outside of healthy parameters in the case of PIU, and that professional help is likely to be helpful or necessary.

INSIGHT: PIU RESEARCH DEMONSTRATES THE ABILITY OF THE TECHNOLOGY ITSELF TO SHAPE US IN INVOLUNTARY WAYS. The multi-aspectual, multi-functioning nature of the framework allows it to address the embedded, static nature of the technology without adopting a completely deterministic psychology which would deny the voluntary capacity of humans that our definition of procrastination requires. This is possible because Dooyeweerd's earlier aspects are deterministic, while the later are norm-based. Thus the framework can address the tension in psychology between voluntary and involuntary action without falling into contradiction.

6.6.5.3 *How can the framework account for the limitations in this area?*

LIMITATION: PIU RESEARCH IS FOCUSED EXCLUSIVELY ON ABNORMAL SITUATIONS REQUIRING CLINICAL INTERVENTION. The activity that makes up PIU seems to directly violate the BIOTIC norm of health and flourishing, while that of procrastination, intuitively, does not. That is, it doesn't seem oxymoronic to talk about procrastination by a healthy, functioning adult; the dysfunction seems to occur in other aspects than the BIOTIC. Thus, while PIU may not be primarily BIOTIC in nature, the framework supplies a distinction that makes PIU qualitatively different than just a really serious case of procrastination. Procrastination is multi-aspectual, but with a heavy emphasis in failure within the ECONOMIC aspect, as someone procrastinating is not spending their time the way that they think is the best use of their limited resources. The framework takes an "everyday" approach to our computer use, making it amenable to considering and understanding the typical user experience in its variety and diversity.

LIMITATION: PIU RESEARCH IS CONCERNED WITH THE INDIVIDUAL PATIENT, AND THE PSYCHOLOGICAL CONDITIONS THAT ARE LEADING TO THE PROBLEM; IT IGNORES THE

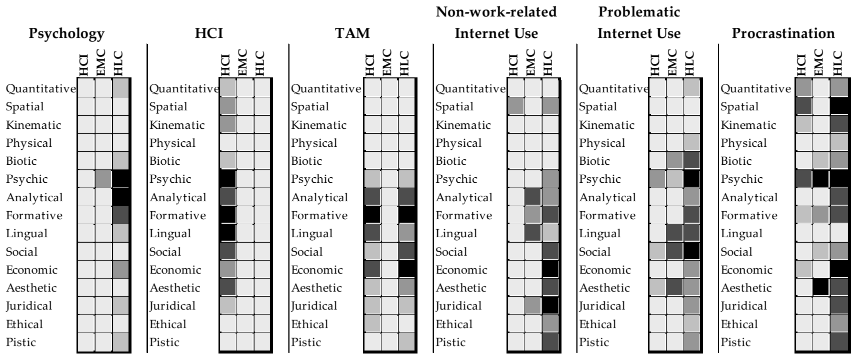

Figure 11: The "big picture" of extant research in computer procrastination

NATURE OF THE COMPUTER AND INTERNET WHICH PRODUCE THIS PROCRASTINATORY TENDENCY. Because PIU is focused on a range of aspects in the HLC functioning, it misses out on the HCI and EMC (where the "nature of the computer" most strongly lies) when looking for insight. The HUCF points to the centrality of the human in multi-aspectual functioning, but does so in a way that allows us to consider and reason about the computer technology itself, particularly by considering HCI and EMC even when the problem manifests in HLC.

6.6.6 *Summary of Existing Research Analysis*

For comparison purposes, Figure 11 gathers all of the previously shown heat maps in one place. This shows that even when we combine the wide variety of different extant research fields, the union of these fields still does not cover all of the meaningful aspects required to explain the complex, everyday experience of computer procrastination. Each of the areas of extant research we have investigated has important contributions to make to this process, but none can, by itself, tell the whole story. The HUCF is capable of accounting for and incorporating each of the extant research areas, and to meaningfully discuss the entirety of the problem.

6.7 findings about procrastination

6.7.1 *Initial Observations*

Examining the primary analysis in Section 6.5, it can be seen that while the symptoms primarily occur in the HLC functioning, all three functionings play an important role in understanding the phenomenon of computer procrastination. This heat-map visualization also demonstrates intuitively how complex the problem is aspectually, with almost all aspects having a direct, unmediated role to play in at least one of the functionings. (Only the physical and lingual aspects are limited to supporting roles with little or no *direct* importance to understanding the problem.)

The spatial and kinematic aspects in the HLC functioning (Table 11) both pertain to the role that *proximity* plays in computer-facilitated procrastination. Procrastination is particularly tempting on a computer because of the ease of switching from one application to another, afforded by the spatial and kinematic functioning in the HCI column. This ease corresponds with the low commitment requirement noted by Lavoie & Pychyl (2001) in Section 6.4.2.1.

The biotic aspect in the HLC functioning (in Table 11) indicates that cues from the body to quit playing are being ignored. Learning to pay closer attention to the cues from the body could drive important changes in the way we use computers. For example, research into the concept of *bodily mindfulness* and various relaxation or meditation practices which can enhance this shows that such a practice may be one route for reducing procrastination (Sirois & Tosti, 2012).

The formative aspect in HLC functioning (in Table 11) indicates that *willpower* and *attention* are key concepts in overcoming procrastination. The scattering of attention away from the task at hand ties directly to the quantitative aspect of HCI – the number of applications that can be open simultaneously introduces the possibility for distraction without needing to leave the computer. This relates to the HCI sub-field which is investigating attention-aware computing, such as Bailey & Konstan (2006).

Finally, we can see that in the pistic aspect, procrastination is resulting from a failure of commitment. That is, if the commitment to the task at hand were sufficient, that sufficiency would be operationalized in terms of having the willpower to see it through. The boredom experienced in the aesthetic aspect in HCI belies this. Instead, we are finding the tasks boring.

It is not surprising that many of these insights have already been noted in isolation in the literature on generic procrastination. While the framework can be used to draw attention to overlooked aspects, and thus to overlooked insights, it also performs a valuable service by showing how the extant insights into the problem fit into the complex computer-use behaviour. This context is important, because it is the computer-use part of the situation that makes the framework appropriate for addressing it.

6.7.2 *Generality of the Example*

Since a single instance of computer procrastination is presented as an example, in Section 6.5, it is natural to ask if the results can be generalized to other situations of procrastination.

- In HCI functioning, if the procrastination is taking place on a desktop PC, much of the earlier aspectual functioning will be similar no matter the application, as the basic layout and interaction with the GUI will result substantially similar HCI issues. For example, in Table 11, the Quantitative aspect of how many applications are open, the kinematic aspect of mouse movement, and the psychic/sensitive aspect of screen perception will all be involved in any computer use involving a modern GUI. The later aspects are more application specific, however, and will tend to vary depending on the procrastinatory activity. The LINGUAL aspect, in which the value of the dice is communicated symbolically, or the AESTHETIC aspect, in which the poor graphical quality of the Yahtzee game becomes clear, would be quite different if the procrastination involved social networking, computer maintenance, or watching online videos instead. However, these later aspects were not seen as significant contributors to the procrastination problem (see Figure 5), and so their application-specificity does not present an objection to the generality of the analysis.

- EMC functioning, by its very nature, will depend almost entirely on the kind of application used for procrastinating. This is because how we engage with the content of the program depends significantly on the nature of that content. However, we can use the insights from psychology and other fields to reason about the kinds of commonalities we expect to find in various procrastinatory activities. For example, as in the given case, applications that feature pleasure (PSYCHIC/SENSITIVE) and fun (AESTHETIC) in their content will be naturally be more tempting as procrastinatory activities than alternatives which do not function like that in these aspects. (Alternately, if an activity is too much fun, it may be be avoided as a procrastinatory activity, because it becomes too difficult to rationalize it as either contributing towards the original task or else worthy of delay (Silver & Sabini, 1981).)

- In the HLC functioning, many of the aspects will involve substantially similar functioning no matter the procrastinatory application. For example, the close proximity (SPATIAL, KINEMATIC aspects in Table 11) of the procrastinatory application is part of the very design of modern operating systems. In the PSYCHIC/SENSITIVE aspect, feelings of frustration (Blunt & Pychyl, 2000) or boredom (Vodanovich & Rupp, 1999) with the original task are common antecedents of procrastination, and feelings of guilt (Fee & Tangney, 2000; Pychyl, Lee, Thibodeau, & Blunt, 2000) and stress (Tice & Baumeister, 1997) are common results; thus many other procrastination examples would also feature these emotions in HLC functioning. Similarly, most of the functioning in the ANALYTICAL, FORMATIVE, ECONOMIC, JURIDICAL, ETHICAL, and PISTIC aspects in Table 11 is not dependent on the particular example of playing Yahtzee instead of writing a blog entry, and would thus be just as likely to be part of HLC functioning with a different procrastinatory application.

6.7.3 *Insight 1: The user is not the only responsible agent; the designer also holds some power.*

One observation brought to attention when doing the HUCF analysis is that the user of the computer does not exercise total control over what happens. There are choices the user would like to make, but is not able to effectively execute. For example, this can be seen in the FORMATIVE aspect of the HLC functioning in Table 11 in which the failure of willpower is noticed. By digging back into some of the earlier aspects, we can see that this failure of willpower does not exist in a vacuum. It takes place within an intricately constructed system of hardware and software technologies, which in turn affect both the amount of willpower available and the amount required to stay on task. For example, the fact that in the KINEMATIC and PHYSICAL aspects the user is sitting very still and expending very little energy may lead to a state of inertia in which the human tendency to "run on autopilot" becomes much stronger than if more physical activity were involved.

As long as the computing application remains unchanged, attempting to address the problem solely through the application of additional willpower on the part of the user won't address the problem in its entirety. The invitation and temptation to procrastinate will continue to exist and play their roles.

When we try to address the factors which contribute to this unfavourable willpower situation, the framework quickly leads us to observe that the user is not the only actor in the situation. The designer of the computer and the creators of the software being used are also, in some sense, present. To address the problem on a more fundamental level will require a different software design. Because at least some of the the primary enabling factors for computer procrastination are largely determined by the design of the software, a completely user-centric, willpower-based approach to overcoming any procrastinatory tendencies is unlikely to be completely successful.

That such approaches are "unlikely to be completely successful" is in no way a fatal critique to such personal, willpower-oriented efforts. Indeed, it has been argued that as our society moves away from an industrial economy and into computer-enabled knowledge work, willpower, and its cousin attention, will be increasingly important human performance characteristics to be intentionally developed. Baumeister & Tierney (2012) make this point thoroughly in their book on willpower, and White (2010) makes this point in his essay on specifically developing strength of will to combat procrastination. However, as Heath & Anderson (2010) point out, relying only on willpower to implement a rationally optimal course of action is to cripple ourselves immensely. Rather, they suggest that in everyday life we make significant use of *environmental scaffolding* to embed our volitional functioning in our environment rather than only in our own brains. In the context of computer procrastination, this means that the computer environment (the hardware, the operating system and application software, and the cultural expectations regarding use) must support such volitional scaffolding. The largest benefits of computer use for greater productivity, and more broadly, for full human flourishing, can be obtained only through intentional and significant design interventions at the early stages of computer construction.

In addition to strategies that the user can adopt, this insight also makes clear that the developer of the system also holds some responsibility for the abilities the system makes available to the user. This echoes the notion of affordance as used by Hutchby (2001), to discuss "the constraining, as well as enabling, materiality of artefacts" (p. 441). The question of how the developer can exercise responsibility across the space and time differences between development and use was addressed in Section 3.8, discussing the notion of how the computer can function as a proxy for the developer, and thus subject to the norms of the later aspects.

The following section outlines one example of such a designer-controlled characteristic tending toward procrastination.

6.7.4 *Insight 2: Ease of access is not always an appropriate goal.*

One insight, observed in Section 6.7.1, comes by recognizing the ease of switching between applications that modern computer systems make possible, and realizing that this is not always desirable. For example, in the vignette introduced in Section 6.1.1, the procrastination was enabled by the ease of switching from a word processing application to a web browser. Many computer users regularly keep a web browser open at almost all times, and switching to it is often a matter of only a few key presses. In such an environment, we can see how easy it is to maintain a "procrastination field", as described by Silver & Sabini (1981), in which procrastinators "keep themselves in readiness to work 'at any moment' by doing things that require only ephemeral involvements" (Silver & Sabini, 1981, p. 218). In this case, switching to a web browser to do a quick search does not remove the procrastinator from their work environment, thus allowing them to more easily deceive themselves that they are still demonstrating commitment to the task at hand.

Recognizing the distinction between HCI and HLC, the HUCF provides the ability to recognize that ease of access, which is a design goal in HCI, may lead to detrimental impacts in HLC. Questioning of assumptions is one of the key ways in which the HUCF contributes insight. In this case, the aspectual analysis of computer procrastination encourages us to question the assumption that ease-of-switching is universal norm to be pursued in all situations.

The ease with which the user can move between programs on the computer is a subset of the larger issue of ease-of-use, and has been a main design goal for personal computers since the widespread introduction of Graphical User Interface (GUI) operating systems in the early 1990s. Under this assumption, the idea that we might make the computer more useful by making it less easy to use is provocative. In seeing the distinction between the functionings and the aspects, the HUCF helps to differentiate the various kinds of norm, and different types of benefit and detriment. For example, ease-of-use can be an appropriate manifestation of *clarity* in the lingual aspect, while enabling an unhealthy *laziness* in the biotic and formative.

It is difficult for us to envision what it would look like for a computer to be designed to make switching between applications more difficult without also having a significant negative impact on its overall productivity. Such difficulty of vision, however, does not necessarily render the task impossible. Creative and intentional design activity may result in a breakthrough which would enable the full productive power of the computer without the distracting tendency to switch that is embedded in the task bar at the bottom of the screen.

This is only likely to be acceptable to users if they perceive that the limitations being put in place are the ones they would chose, at least if they were in full possession of willpower. This type of precommitment is well-recognized in the psychology literature.

For example, Ariely & Wertenbroch (2002) define this strategy by stating that "what characterizes binding behaviour is the voluntary imposition of constraints (that are costly to overcome) on one's future choices in a strategic attempt to resist future temptations" (p. 219).

One form of "software-enforced pre-commitment device" is when the user installs software such a *LeechBlock* (Anderson, 2013) to specify ahead of time which websites they don't wish to be able to visit at certain times of the day, and the software then enforces this decision later on, when their willpower alone would not have kept them from wasting time. If the procrastinatory activity is more sophisticated and difficult to define precisely, advanced artificial intelligence techniques may be able to help. For example, advanced pattern-recognition algorithms may be able to determine whether the user is procrastinating and redirect the user back to the productive activity. Of course, implementing such a "mechanical" system to supplement willpower would need to be done thoughtfully, as there is significant potential for subtle but severe unintended consequences when altering the human experience of agency and responsibility while using a computer.

6.7.5 *Insight 3:* PSYCHIC/SENSITIVE *functioning in EMC and HLC shows a tension present; this might be exploitable for design change.*

The human meaning that occurs in the PSYCHIC aspect in the procrastination case study (Table 11) uncovers an interesting feature of procrastination which may point towards a possible design intervention.

The HUCF allows us to understand and explain the apparent paradox of procrastination, in which the person simultaneously wants to perform the procrastinatory behaviour and does not want to do so. It does this by separating out the EMC from

HLC. We can see in Table 11 that the enjoyment and fun of the procrastinatory activity manifest in the PSYCHIC/SENSITIVE and AESTHETIC aspects of EMC functioning, but that the same aspects in HLC exhibit guilt, stress, angst, dissatisfaction, and dysfunction.

This observation that PSYCHIC/SENSITIVE functioning in EMC is primarily positive while the same functioning in HLC is primarily negative points to the psychological complexity of procrastination behaviour. It also, however, alludes to the possibility that, with clever design, some of the angst experienced in the HLC functioning could be integrated into the experience of the content itself. By "poisoning" the illusory pleasure of procrastinating, felt primarily in EMC functioning, the overall PSYCHIC/SENSITIVE experience of procrastination would become more psychologically authentic. Because the user experiences procrastination negatively in the big picture of their life, experiencing it as negative at the exact moment it occurs would be emotionally accurate. The design changes required to do this would be unconventional and creative, and would also differ depending on the nature of the procrastinatory activity being thus poisoned.

For example, the Facebook social networking site is a frequent procrastinatory activity online (Giannakos, Chorianopoulos, Giotopoulos, & Vlamos, 2013). There are numerous benefits and gratifications which motivate users to use Facebook; Spiliotopoulos & Oakley (2013) identify seven factors, including:

- social connection (such as connecting with distant friends)
- sharing identities (joining with like-minded people)
- photographs
- content (such as applications, games, and quizzes)
- social investigation (such as virtual "people-watching")
- social network surfing (looking at the profiles of people you don't know)

- the newsfeed (seeing what your friends have posted for their status message)

The majority of these are primarily related to the content, and thus the attractiveness of participating lies primarily in the EMC functioning. Social connection and shared identities involve both meaningful content and the feelings of rich social connectedness in everyday life, and thus are functioning in HLC as well.

Though the user may recognize the benefit of a meaningful social connection as an everyday good which Facebook can help to provide, the fact that it has been self-identified as a procrastinatory activity indicates that, in this circumstance at least, they are using it against their better judgement. That is, even though they are enjoying the content in EMC, they recognize that the overall life impact in HLC of this particular use is detrimental. The goal of a design intervention, in this case, would be to alter the EMC functioning to make it less enjoyable, and thus to enable the user to more easily follow their own better judgement.

This might take the form of:

- Embedding messages within the "Facebook Newsfeed" reminding the user of their alternate commitments
- Truncating the availability of updates to an abbreviated list of friends
- Limiting certain types of content, such as links to videos or off-site essays, which take additional time to consume or are more likely to lead to extensive off-task browsing
- Displaying a timer which shows how long the user has spent on the site today

Any of these methods might make the temptation to stay on Facebook after switching in the middle of task easier to overcome. This approach is complicated by a number of factors, including:

- Use of the application is not anti-normative in and of itself. There are many situations in which it may be a perfectly appropriate activity. The difficulty comes only when the user is using it despite having previously decided that something else would be the wisest use of their time. Thus any of the above measures would only be appropriate to implement on a temporary or part-time basis. It is difficult to algorithmically determine whether any particular use is appropriate at any given time.
- The application in question, Facebook, is run by a corporation which makes money by selling advertising. Their financial incentive to keep the user coming back may not be entirely compatible with the user's desire to use it more moderately.

6.7.6 *Insight 4: Computer procrastination cannot be understood if any of HCI, EMC, or HLC is missing.*

The use of the HUCF helps point out the necessity of thinking about multiple types of human functioning when seeking to understand what's occurring when a person uses a computing device. The example of procrastination demonstrates that HCI, EMC, and HLC are all necessary for understanding the behaviour:

- HCI demonstrates the ease of switching that allows the procrastinatory activity to be initiated with a low level of effort required.
- EMC shows how any individual procrastinatory activity must be attractive enough – at least when compared to the unpleasantness or angst induced by the original activity – to be switched to.
- HLC demonstrates how the procrastination does "return to bite" the procrastinator in terms of both short term guilt and long term stress and dissatisfaction.

Thus, even though the aspectual features of computer procrastination come to their fullest expression only in HLC functioning, there is still meaningful functioning that is crucial to the procrastination phenomenon that occurs in the HCI and EMC categories. This is important, because it is these two functionings which are unique to the computer use situation, and which are directly affected by the design and implementation of the software. Because these factors can be addressed at design time, hope for software design alternatives to reduce the temptation to procrastinate lie here.

This insight demonstrates that computer procrastination is indeed distinct from generic procrastination, and will thus require additional insight to fully understand.

6.7.7 *Findings about the Framework*

This analysis also demonstrates the richness of the possible relationships between the three human functionings, which were introduced in Section 3.6. In a single case, we can see:

- First and most intuitively, we find there are purely horizontal relationships, in which we can see the the same aspect or aspects at work among different functionings:

  Consider, for example, the SPATIAL and KINEMATIC aspects listed in Table 11. We can see that the HLC functioning in the SPATIAL and KINEMATIC aspects is directly enabled by the HCI functioning in those aspects. This is an example of HCI affecting HLC functioning.

- Second, we could have a situation in which an aspect, such as PSYCHIC/SENSITIVE in this example, is important in all three functionings, but for largely unrelated reasons.

  The PSYCHIC/SENSITIVE functioning in HCI has to do with perception of the interface itself. The feelings of enjoyment in the EMC functioning are largely unrelated to the workings of the interface, however. The game of Yahtzee would presumably be just as enjoyable and as tempting for procrastination with a touch-based interface as it is with the mouse-based one. And, the feelings of guilt and stress in HLC need not be directly due to the enjoyment in EMC. The stress of not doing what ought to be done would exist even if the procrastinatory task were menial and boring, though perhaps the guilt would be less.

- Third, there are interaspectual/interfunctionings relationships – i.e., HCI SPATIAL affecting HLC ECONOMIC.
  - In the Yahtzee example, the SPATIAL/KINEMATIC aspect in HCI functioning enables good ECONOMIC functioning in HCI, which makes the game more fun, which is the AESTHETIC aspect in EMC. In part because of this AESTHETIC fun, the procrastination problem manifests in HLC functioning. This is an example of EMC mediating the influence between HCI and HLC.
  - This type of analysis can add richness to the analysis, and demonstrates the complexity of many computer use situations. However, if used injudiciously, it could descend into "everything affects everything" thinking. Though this may be true philosophically, it is not likely to be useful analytically, as some relationships between aspects and functionings are more central to understanding the use case in question than others.

6.8 CONCLUSION

6.8.1 *Summary*

In this chapter, a full scale research project was undertaken to assess whether the HUCF is capable of producing usable insight when used to analyse a problematic computer use situation, computer procrastination. This began with an in-depth effort to characterise the exact problem under investigation in Section 6.2, resulting in the five-part characterisation shown in Section 6.2.2. The research approach being used in this "mini-thesis" was briefly described in Section 6.3 on page 133. Next, Section 6.4 reviewed several distinct areas of research literature that may contribute to understanding the problem of computer procrastination. While each of these areas is able to furnish valuable insight, none can provide a full understanding on its own. This led to two questions:

1. How can we understand computer procrastination?
2. Why is existing research unable to fully account for this problem?

In order to answer the first of these questions, an HUCF Primary Analysis was undertaken in Section 6.5, which was able to provide a complete picture of the entire computer use situation during a procrastinatory episode. The second question was answered by a series of five respective HUCF Existing Research Analyses, which were able to account for the insights and limitations of each field.

Finally, Section 6.7 detailed a number of findings from the study, including multiple insights into the computer procrastination problem which could be helpful in designing solutions to the problem.

6.8.2 *Limitations*

6.8.2.1 *Definition of Procrastination Is Not Universal*

The definition of computer procrastination arrived at in Section 6.2.2 may not be universally agreed upon by practitioners from the various other fields. This is to be expected; indeed, a significant reason why PIU and NWRIU don't address computer procrastination well is precisely because the phenomenon they study has a differing definition than the phenomenon of computer procrastination defined above. By specifying the problem differently than existing research approaches do, a new and different problem can be investigated and addressed. The use of the framework aids in this distinction by forcing consideration of the exact PSYCHIC/SENSITIVE, ANALYTICAL, and FORMATIVE character of the problem being researched.

6.8.2.2 *Design Changes Not Tested*

A second limitation of the work in this chapter is that, although the analyses demonstrates that helpful design changes are possible, and even suggests a few such changes (for example, in Section 6.7.5), these design changes have not been implemented and tested empirically for efficacy. However, the focus of this work is on developing new insight into the problem, which is a first step towards solving it, rather than the whole solution. With these new insights in hand, future research into this problem is better positioned to make progress in solving it.

6.8.2.3 *Procrastination Research in Education*

One additional area that has performed significant research into procrastination is in the field of education, which has looked at the causes and effects of students procrastinating in their studies. With the significant push to understand the benefits and challenges of online education, a number of such studies have examined online procrastination in the context of digital leaning systems. Because the majority of such research is an extension of the approach taken in general psychology to understanding psychology, this field was not included in the literature review of approaches to understanding procrastination. While this stream of research has a much narrower focus than the larger issue of computer-induced procrastination in general, it is possible that some of the insight into digital procrastination emerging from studies of online education could be generalised to the broader issue of computer procrastination.

6.8.3 *Contributions*

6.8.3.1 *Computer Procrastination is a Unique Phenomenon*

The first contribution of the research in this chapter is the demonstration that computer procrastination is a unique problem, distinct from generic procrastination, and also from Problematic Internet Use, and NWRIU. In addition, an understanding of why it has not be previously addressed in the academic literature was developed. By demonstrating the hole in the literature, a challenge has been posed to the relevant research fields (primarily the psychology of procrastination and the HCI fields) that this is a distinct issue which can be and needs to be addressed.

6.8.3.2 *The Developer is Partially Responsible*

Second, the analysis demonstrated that while the procrastination necessarily involves the voluntary action of the user, that user's choices and exercise of willpower exist in a context largely created by the developers of the computer system being used. This implies that the developers share some of the ability and responsibility to alleviate the problem through better design.

6.8.3.3 *Design Change is Possible to Lessen the Temptation*

Third, as part of the above point, the analysis makes it clear that the procrastinatory tendency in computer use situations need not be inherent in the nature of computers themselves, and that there is thus room for creative design to alleviate the problem. While the exact nature of such design changes will be dependent on the nature of the individual applications and the entire computer systems which implement them, strategies for possible modifications to existing software were presented.

7 DISCUSSION

7.1 INTRODUCTION

The previous two chapters, containing the collection of smaller analysis examples and the large main example of computer procrastination, form the main results of this thesis research. Before moving on to detail the findings, in Chapter 8, it is necessary to collate and discuss some of the immediate observations made in the results. In some cases, this will be a restating of claims that were part of stating and exploring the framework itself in Chapter 3, but this time demonstrated using the analyses that forms the results chapters.

Doing this will lay a firmer groundwork for the findings in Chapter 8.

7.2 ASPECTS ARE A GOOD TOOL FOR UNDERSTANDING DIVERSITY IN ALL THREE OF THE HUMAN FUNCTIONINGS

The first confirmation made by performing these analyses is the observation that the use of Dooyeweerd's modal aspects are an excellent method for uncovering the diversity that is present in all human functioning. At the heart of Dooyeweerd's thought is the observation that everyday life as experienced pretheoretically is inevitably complex and diversely meaningful. Thus the task of theoretical thinking is to isolate the various ways in which things are meaningful so that they can be studied individually. In this way, detailed, theoretical understanding can be built up. One use of aspects as a tool, in this context, is to help ensure that we aren't overlooking any modes of meaningfulness.

In the context of the HUCF, the particular diversity we're interested in understanding is that which occurs in each of the three human functionings in the framework, HCI, EMC, and HLC.

For example, in the case study on purchasing a train ticket online (Section 5.3), the chaotic complexity of considering all that is "going on" during that computer use becomes more orderly and structured when analysed using the aspects. While there remains significant subjectivity and room for debate on the particulars, the aspects provide a useful vehicle for clarity about what is being debated. For example, in Table 6, one could argue that the concept of leg room, which I have put in the BIOTIC/EMC category, really belongs in the PSYCHIC/HLC category. (That is, it could be argued that the concern about leg room isn't in the content of the application but about the lived experience of using [or having used] it, and that it isn't about the biological length of my legs, but about the PSYCHIC experience associated with a seat that is too small.) Even with this subjectivity, simply having the discussion is a useful prompt for clarifying the nature of what is being discussed.

In the example of working out on a computer-controlled exercise machine (Section 5.4), a designer could use the aspectual analysis to scan for areas of improvement. In this case, the empty slot in SOCIAL/EMC might prompt them to consider if adding social features to the content of the display might make the machine more engaging to use, and if so, whether that would be worth the significant additional cost and complexity that would take. The ETHICAL/HCI category shows that insufficient attention has been paid to the "little details" of good design.

Finally, in the central example of computer procrastination, we can see that the use of aspects provides a mechanism to uncover ways in which the situation was meaningful that had previously been overlooked. The FORMATIVE functioning of HCI and EMC in Table 11 identified that the interface was used to build and shape, in some small way, the structure of the game being played. In HLC functioning, I had not previously considered that procrastination is a form of social disrespect, but it became clear through the analysis that one of the repercussions of the pistic breaking of faith was a form of disrespect towards those who were expectantly waiting for the results I had promised. This is also related to the dysfunction in ethical HLC functioning, in which the self-indulgence of procrastination was manifest.

7.3 the three human functionings need to be understood separately

A second observation that can be made on the basis of the previous analyses is that each of the three human functionings, the three ways in which we engage when using the computer, must be distinguished from the others when trying to gain understanding. Failing to do so will result in blurred lines and confusion.

Look, for example, at the analysis of the Pandora streaming music service in Section 4.5.1. In this case, if I did not sufficiently distinguish between, for example, the HCI and the HLC functioning in the economic aspect (see Table 2), I would overlook the distinction between wasting time navigating a clumsy interface, and wasting time reading musician biographies. These are distinct kinds of time-wasting, because the former is due to poor design, while the later is due to using the system exactly as the original designers envisioned it would be used.

Similarly, in the procrastination example (Table 11), the distinction between EMC functioning and HLC functioning in the psychic/sensitive aspect is a pivotal point of the analysis. In EMC, there is the enjoyment and pleasure of playing the game. In the HLC functioning of that same aspect, we see guilt, frustration, and angst. If we restrict our gaze to only the engagement with the content, we are unable to see any dysfunction. The negative functioning doesn't become apparent until we expand our view and perceive the entire human life within which this game-playing takes place. An analysis which would not distinguish between the various functionings and attempt to understand them as an undifferentiated whole would miss this key insight.

7.4 ASPECTS AND FUNCTIONINGS HAVE INHERENT NORMATIVITY

The next observation to point out is that all of the components of the HUCF exhibit intrinsic normativity. This includes the norms of the later aspects and norms for the three human functionings. The norms for the aspects themselves are described in Section 3.3. in addition to the aspects, each of the three functionings also has a built-in normativity of its own. Basden suggests that each type of human engagement must attempt to meet all of the aspectual norms, but must do so in a way that respects the uniqueness and unity of that engagement. He suggests that the overarching normative goal for HCI is usability, for EMC is justice to the virtual world of the content, and for HLC is shalom (Basden, 2008, pp. 146-153). These are briefly summarised below.

USABILITY IN HCI A truly usable system will not maximize only productivity (ECONOMIC aspect) or eye-catching design (AESTHETIC aspect) but will harmonize all of the aspectual norms, particularly respecting the unique role the LINGUAL aspect plays in well-done HCI functioning.

JUSTICE TO THE VIRTUAL WORLD IN EMC The content of each program is different, and the normative functioning of EMC engagement honours those differences by specifying that the meaningfulness of the domain which the program addresses should be present in the content itself. For example, the ways in which a database program, an email program, a scientific simulation, and a game each have their own unique meanings across the aspects should be reflected in how functionality in those aspects is implemented.

SHALOM IN HLC Normativity in the HLC context – the big picture of our lives as lived – is characterised in the broadest way as that which brings about shalom – a rich, peaceful condition in which all is "as it ought to be". In the Dooyeweerdian view, this must be characterised as harmony among the aspects. In practical terms, achieving it often requires identifying and rectifying situations in which a single aspect is being absolutised or overemphasised.

This diversity of normativity in the human functionings can be seen in the example of the grade report mail-merge (Section 5.1). The difficulties encountered in operating the mail-merge function in HCI are orthogonal to the difficulties encountered in making the grading system fair (EMC) and in treating the students as whole, unique humans rather than rows in a spreadsheet (HLC). Because the types of normativity are distinct, the relationships between the engagements are complex, as we'll see in the next section.

7.5 THERE ARE MULTIPLE KINDS OF RELATIONSHIP BETWEEN THE HUMAN FUNCTIONINGS

As seen is Section 3.7, the relationship between the categories of functioning within the HUCF is of multiple kinds:

- There is the stance in which HLC functioning is recognised as primary, with the importance of HCI and EMC only emerging because of their impact on HLC.

- There is a stance which recognises that HCI is the only functioning that is PHYSICALLY based, and thus plays a foundational role in enabling the other functionings to exist in the first place.
- There is the stance which recognises the central, mediating nature of EMC functioning, since the content of the program is what makes use of the computer meaningful in the life of the user at all.
- There is the flow of normativity between the developer-controlled HCI and the user-dominated HLC, explored in Section 3.7.5, in which the kind of dysfunction in HLC determines whether improving the HCI and EMC functioning will improve or exacerbate the HLC functioning.
- There is the Shalom principal, articulated in Section 3.7.6, in which the proper functioning in any one functioning both depends on and enables proper functioning in the other two.

These five kinds of relationships can be seen in the case study on procrastination, analysed in Table 11:

- The leading nature of the HLC functioning can be seen in the ECONOMIC/HLC category, in which the fact that the activity is a waste of time is central to its identification as procrastination. PISTIC/HLC functioning, in which procrastination can be seen as breaking faith with myself over my own commitments is where the procrastination becomes the most existentially painful.
- The founding nature of the HCI functioning can be seen in the PSYCHIC/SENSITIVE/HCI category, where the ability to perceive the elements of the game on the screen is what makes possible all of the other functioning that is occurring. The SPATIAL/HCI and KINEMATIC/HCI are at the root of the problem, in which switching between applications is both physically and psychologically very easy.

- The mediating nature of the EMC functioning is visible in the PSYCHIC/SENSITIVE/EMC and AESTHETIC/EMC categories in which the game is enjoyable and fun – this is the meaning that the content provides in my life that makes the activity at least superficially attractive. Without this, the procrastinatory activity might not take place.
- The flow of normativity can be seen in that the dysfunction in HLC depends on some parts of the HLC and EMC functioning, but not on others. In particular, the AESTHETIC/HCI and AESTHETIC/EMC aren't the cause of the procrastination, and thus improving functioning in these categories would not improve the HLC functioning but make it worse. Alternately, the HLC dysfunction *is* due, in part, to the SPATIAL/HCI and KINEMATIC/EMC functioning, so improving those areas, by making it more difficult to switch away from my intended activity, would improve the overall normativity of use.
- The Shalom principal can be seen in all of the above areas, and also in the disconnect between PSYCHIC/SENSITIVE/EMC and PSYCHIC/SENSITIVE/HLC, where the content of the game is enjoyable, belying its actual effect in everyday life where it is a cause of angst and guilt. This disharmony between functionings is indicative of a breakdown in shalom between functionings.

7.6 THE HUCF CAN HELP TO UNDERSTAND WHY COMPUTER PROCRASTINATION IS NOT WELL TREATED BY ANY EXISTING BODY OF WORK

One of the claims of the framework is that it is able to constructively engage with other ways of understanding computer use. Joneidy & Basden (2013) show how the framework can be used to simultaneously affirm, critique, and enrich other approaches to understanding computer use. In this thesis, this was demonstrated in Section 6.6, in which each of the five other areas that make contributions towards understanding computer procrastination were analysed using the HUCF.

Each of these areas had key insights, but also significant limitations in understanding the problem. Using the HUCF to analyse these areas helped to integrate those insights into a useful whole. It also helped produce a profile of the procrastination problem that made it clear why it seems "invisible" to many other research areas. In these ways, the framework is able to both help integrate insight from multiple areas into understanding any particular computer use situation, and also provide valuable critique and suggest new fruitful directions for research to these other areas.

7.7 DOOYEWEERD'S NOTION OF SUBJECT AND OBJECT MAY NOT BE NUANCED ENOUGH TO INTUITIVELY UNDERSTAND THE NATURE OF RESPONSIBILITY OVER DISTANCE

Dooyeweerd posits a very unique conception of subject and object. He uses the word *subject* in a literal sense of "being under"; an entity is *subject* in an aspect if it is under (subject to) the laws of that aspect. Inanimate objects are subject to the QUANTITATIVE, SPATIAL, KINEMATIC, and PHYSICAL aspects, but are not subject to the laws of BIOTIC life, or the remainder of the aspects. That is, a hammer must obey the PHYSICAL law of gravity, but the ECONOMIC law (norm) of *frugality* is meaningless to a hammer. The hammer can, however, be an *object* of the ECONOMIC aspect, as when it is bought or sold, or used wisely or wastefully. In this scheme, plants are subject in the aspects through the BIOTIC, and animals through the PSYCHIC/SENSITIVE (or, some argue, the ANALYTICAL or even the FORMATIVE), but only humans are subject in all 15 aspects.

The reason this comes up when discussing responsibility is because, as an inanimate object, a computer system is only subject to the aspects through the PHYSICAL, which means that speaking of the responsibility of the computer itself is nonsensical. Because the laws of physics are determinate, allowing no choice in the matter for the computer, there is no *ability to respond*, and thus no responsibility. However, as seen in Section 6.7.3, at the time of use, the user does not exercise sole responsibility for the nature of the use, but the distance at which the developers are "present" makes it awkward to reason about their responsibilities in a meaningful way. Because software is something that, to some extent, "runs by itself" after being set in motion by humans, it would be philosophically helpful if we could view the computer itself as holding some of the responsibility for normative use. The Dooyeweerdian foundation of the framework forbids this.

Addressing this impasse was the purpose of introducing the Subject-by-Proxy proposal in Section 3.8. By thinking in terms of the computer system acting on behalf of the developer, we can picture more intuitively how the developers' responsibility extends across time and space to be shared with that of the user at the time of use.

7.8 CONCLUSION

In this chapter, I have used the results of the analyses in Chapters 5 and 6 to elucidate a number of observations about the HUCF which were implicit in the description of the framework in Chapter 3, but were made explicit by the research in this thesis. These observations about the framework will be helpful in demonstrating the findings of this thesis in the next chapter.

8 FINDINGS

8.1 INTRODUCTION

This chapter summarises the major findings from this thesis research, and demonstrates how they come from the results. The five findings are:

1. The HUCF provides fresh insight into complex problems.
2. The HUCF helps uncover hidden aspects.
3. The HUCF is flawed, but can be amended.
4. The HUCF can help alter the user's behaviour in using the system.
5. The HUCF can help better understand and appreciate existing approaches.

Each of the following sections will review one of these findings, refer back to the previous parts of the thesis that lead to this finding, and discuss its implications.

8.2 THE FIRST FINDING: THE HUCF PROVIDES FRESH INSIGHT INTO COMPLEX PROBLEMS

As shown in Section 4.4.1, the problem of computer-based procrastination makes a good use case for the framework, and the insight generated by way of that analysis provides a good example of the kind of insight we might expect the HUCF framework to open up in other use case analyses. A number of these insights are summarized below, and a description of how that insight is uniquely arrived at using the HUCF is in the subsections following.

1. The user is not the only responsible agent; the designer also holds some power
2. Ease of access is not always an appropriate goal
3. Psychic/Sensitive in EMC and HLC show a tension present; this might be exploitable for design change.
4. Computer procrastination cannot be understood if any of HCI, EMC, and HLC is missing.

8.2.1 *Preliminary Considerations*

8.2.1.1 *What Is Insight?*

To understand what I am claiming with this finding, we must first have an understanding of what is meant by the word *insight*. This may not be as trivial as it might first seem. An entire book edited by Davidson & Sternberg (1995) discusses the concept in depth, but in the final chapter admits that "after reading this book, one may be a bit perplexed about exactly what insight means" (Schooler et al., 1995, p. 560).

Lonergan et al. (1992), in discussing insight in its "verb" form, suggest that:

> By insight, then, is meant not any act of attention or advertence or memory but the supervening act of understanding. It is not any recondite intuition but the familiar event that occurs easily and frequently in the moderately intelligent, rarely and with difficulty only in the very stupid. In itself it is so simple and obvious that it seems to merit the little attention that commonly it receives. At the same time, its function in cognitional activity is so central that to grasp it in its conditions, its working, and its results

> is to confer a basic yet startling unity on the whole field of human inquiry and human opinion (p. 3).

However intuitive, describing insight in an active sense is not very useful to us in deciding what is meant by "providing fresh insight into complex problems," because it doesn't specify what kind of relationship should occur between the insight and the problem it is addressing. A better approach is provided by Weisberg (1995), who assumes that insight occurs in the context of a problem which is eluding solution, and suggests that "insight occurs when a problem is solved through restructuring: That is, if we compare the initial solution attempt(s) with the insightful solution, they must be the result of different analyses of the problem" (p. 163). Thus, in order to demonstrate that the HUCF has provided fresh insight into a problem, it will be sufficient to show that the framework has enabled a new and novel analysis of the problem. The problem can now be seen from a new angle or through a new lens, revealing that which was previously obscured.

As the HUCF is built upon the philosophy of Herman Dooyeweerd, it might also be helpful to visit what he means by the notion. While he does mention it in a seminal passage, his use is characteristically impenetrable:

> Theoretical intuition, actualized in synthetical thought, is no more detached from pre-theoretical intuition, operative in enstatic thought, than the transcendental direction in the cosmic order of time is detached from the foundational direction. In the inter-modal synthesis and analytical disjunction of the modal aspects of experience our theoretical intuition is actualized in synthetical thought as *insight*. It can only be understood as a deepening of pre-theoretical intuition, to which it must always refer in the foundational direction of time (Dooyeweerd, 1955–1958, Vol. 2, p. 479; emphasis in the original).

Ignoring for the moment the rich fountain of meaning intended behind a phrase like "the transcendental direction in the cosmic order of time", what Dooyeweerd is saying here is that insight is what becomes *actualized* when theoretical (abstracted) intuition is synthesised across the various aspects of meaning. (See Section 3.3 regarding Dooyeweerd's use of *aspects*.) What was merely *theoretical* intuition when the aspects were considered in isolation becomes concrete, helpful problem-solving insight when the meaningfulness and lawfulness of all aspects of reality are brought back together after being broken apart in the act of theoretical abstraction. This notion of insight is not identical to the one given above by Weisberg (1995), but is compatible with it.

Also note that this conception of insight does not rely heavily on a notion of *suddenness* which is a characteristic of many definitions suggested in Davidson & Sternberg (1995). That is because the restructuring of the problem suggested by Weisberg (1995) does not rely on a sudden understanding – a "light bulb moment" – for its efficacy in solving a difficult problem.

8.2.1.2 *What Is Meant by "Fresh"?*

"Fresh insight", in this context, does not then necessarily mean observations which no one has made before, but rather that the problem has been viewed through a new lens, resulting in seeing the observations in new combinations. In this way, the framework can suggest new courses of action, or make existing suggestions more forcefully, based on existing observations. In the example of computer procrastination, this is important, because the observations made in, for example, Table 11, are not generally brand new observations of phenomena and meanings that have previously gone unnoticed, but rather are seen together in a new arrangement that suggests new emphases or courses of action. In this way, we can see that the framework is not meant to *replace* existing frameworks for understanding computer use, but to *augment* or *enhance* them.

8.2.2 *Insight 1: The User Is Not the Only Responsible Agent; the Designer Also Holds Some Power*

This insight, discussed in Section 6.7.3, is built on the observation of the relationship between HCI and HLC in the SPATIAL and KINEMATIC aspects in the HUCF Primary Analysis of the procrastination case (Table 11.) There, we notice that later failures in willpower (FORMATIVE aspect of HLC functioning) stem from the ease of switching, and thus amount of willpower needed to refrain from doing so, in the earlier aspects.

From this, we can conclude that to address the problem on a fundamental level will require a different software design. The existing design, while not *determining* the action of the user, does *constrain* it. This observation is echoed in Hutchby (2001) where he argues for the notion that *affordances* are built into the artefact at design time. The affordances of objects are "the possibilities they offer for action" (p. 447). The affordances that a particular technological artefact offers limit the range of actions of the user. "When people interact through, around or with technologies, it is necessary for them to find ways of managing the constraints on their possibilities for action that emerge from those artefacts' affordances" (Hutchby, 2001, p. 450).

Research on affordances in computer technology focuses most heavily on HCI concerns, since the interface is, by definition, where affordances can be perceived. However, by not considering the distinction between the interface and the content – between HCI and EMC – the discussion of affordances and perceived affordances, such as in Norman (1999), is impoverished. For example, in the case of computer procrastination, modern operating systems offer the affordance, both real and perceived, to rapidly switch between applications. Norman's (1999) concept of adding constraints to the interface could be of great benefit here, but only if done with sensitivity to the EMC category of functioning, so that the addition of the constraint did not negatively affect the task at hand.

This insight is not "fresh" in the sense that no other scholars have observed this; many have. It does provide new context to the observation by viewing the situation through a new lens. In particular, by distinguishing that the designer holds most of the responsibility for HCI functioning, and quite a bit of it for EMC functioning, but relatively less for HLC functioning, it provides guidance for where to look for design alternatives when trying to address problematic HLC functioning.

This insight also led to the exploration of how the responsibility a designer carries can play out across the space and time between the design process and when the artefact is used. I introduced the concept of "subject by proxy" (Section 3.8) to provide a mechanism for reasoning about how a computer program may display some characteristics of normative functioning in the later aspects without requiring that it hold actual moral agency.

8.2.3 *Insight 2: Ease of access Is Not Always an Appropriate Goal*

The second insight from Section 6.7 is to note that, as in the procrastination case, ease of access – in this case, ease of switching – may not be a suitable goal to ensure optimal computer use.

This insight extends beyond the issue of procrastination, and poses a challenge to all HCI functioning, and indeed, to the development of all technology: *Making something easier to do is only good if that thing is also the right thing to do*. The rich diversity of norms available in the HUCF can be very helpful in addressing this challenge, because it provides a way to think about varied repercussions.

The suggested course of action to take – making switching between applications more difficult – has been recommended by others. It is is made more forcefully here through the use of aspects, which allow us to see how the SPATIAL and KIN-

EMATIC functioning contribute to problematic situations in later aspects.

8.2.4 *Insight 3:* PSYCHIC/SENSITIVE *in EMC and HLC Show a Tension Present; This Might Be Exploitable for Design Change.*

This insight, discussed in Section 6.7.5, stems from the distinction between PSYCHIC/SENSITIVE EMC functioning and HLC functioning in a procrastination situation. In particular, the attraction of the procrastinatory activity took place while engaging with the content, which was found enjoyable, while negative affect occurred in HLC, with feelings of guilt and stress.

As described in Section 6.7.5, it is possible to envision design choices which have the real-world (HLC) consequences of procrastination infect the content (EMC functioning), and thus make the content less attractive as a procrastinatory alternative to the original task.

Computers are good at reminding us of appointments or received messages. They may equally-well facilitate keeping values and goals in the scope of our attention, particularly when such values and goals are imperilled by procrastination. This would result in software which makes the relationship between our current action and our desired outcome more tangible. For example, if procrastination necessarily involves irrationality, the computer could highlight that irrationality as part of the content of the procrastinatory activity. This computer-induced cognitive dissonance could only be resolved by stopping the procrastination and getting back to work.

The courses of action suggested in Section 6.7.5 come about because the problem has been restructured by viewing it through the lens of the framework.

8.2.5 *Insight 4: Computer Procrastination Cannot Be Understood If Any of HCI, EMC, and HLC Is Missing.*

Insight 4, while important for demonstrating that computer procrastination is distinct from generic procrastination, also demonstrates the utility and validity of the HUCF itself. Consider the richness that the framework introduces, which can be seen in the PSYCHIC/SENSITIVE aspect (Table 11). In the HCI functioning, the PSYCHIC/SENSITIVE aspect is important because it underlies the possibility of true interaction. In EMC, the PSYCHIC/SENSITIVE aspect allows for enjoyment of the game, while simultaneously, the HLC PSYCHIC/SENSITIVE aspect involves negative affect, with both feelings of frustration or boredom from the original task and feelings of guilt and stress from engaging in the procrastinatory task. Contrast this aspect, which is important in all three categories of functioning, with the ECONOMIC aspect, in which the central failing of procrastination – that it is an imprudent use of time – becomes clear only in the HLC functioning (Table 11) while the ECONOMIC HCI and EMC functionings do not appear to directly contribute to the problem.

8.2.6 *Insight 5: With Interfaces, Less Is Often More*

This insight stems from the analysis of working out on the exercise machine, in Section 5.4. In this case, the analysis pointed out that the highly constrained nature of the application allowed a simplicity of interface that made it fairly simple to operate. The notion that a simple interface is preferable to a complex one is universally acknowledged, but the HUCF allows us to see the way a simple interface can still do justice to the richness of meaning in the content. For example, in Table 7, the LINGUAL HCI functioning includes the use of symbols, such as a heart symbol or a staircase symbol, to communicate which measurement is being reported in the numeric display (pulse rate or distance climbed, in this case). This is then translated, in EMC functioning, to aspects like BIOTIC (heart rate) and AESTHETIC (the satisfaction or meeting a challenge) or PISTIC (the commitment to achieve certain fitness goals). A cluttered interface would not allow the EMC to display this richness nearly as well.

A preference for simple over complex is, of course, not a new observation. But, by seeing the connections between HCI and EMC, and between EMC and HLC, the HUCF makes this point more forcefully.

8.2.7 *Review*

In this section, we have seen five examples of insight that comes from using the framework to analyse a computer use situation, four from the main example of procrastination, and one from a smaller example analysis in Chapter 5. This finding is supported by the observations from Chapter 7. Section 7.3 showed how each of the three functionings can bring additional understanding to a situation and urges us to look for these functionings. Section 7.2 recapped how the use of aspects gives us a way to deal with the diversity of meaning in each functioning. Section 7.5 shows that there are multiple kinds of relationships possible between the functionings, with the highest level of benefit coming about when the shalom relationship is in play. Finally, Section 7.4 emphasises that normativity is inherent in all three of the functionings, and is of diverse kinds, with the implication that there are always better and worse ways to function in each of the engagements, and that any complex problematic situation can thus always be improved in some way. In demonstrating the ability of the HUCF to generate insight, Objective 1 from Section 1.5.2 has been met.

8.2.8 *Other Complex Problems*

Because this finding claims that the HUCF is valuable for finding insight into complex problems in general, rather than merely procrastination in particular, it seems reasonable to compare it to another complex, unsolved problem involving computers. Consider, for example, the problem of Cyber Bullying (Mishna, Cook, Gadalla, Daciuk, & Solomon, 2010). In this problem, young persons use computer and internet technologies to send or publicize messages which inflict wilful harm on others repeatedly, often including e-mail, text messages, and social networking, to embarrass, annoy, frighten, or intimidate their victim. Some of the same complexity hallmarks of the procrastination problem show up here as well. Consider:

- The portable nature of cell phones which allow the bullying to take place "any time, anywhere": SPATIAL/HCI, PHYSICAL/HCI.
- The sending or requesting of sexually explicit imagery: BIOTIC/EMC.
- Sending messages: LINGUAL/EMC.
- Selecting the audience who will read the message: FORMATIVE/HCI.
- Difficulty for the victim to erase the offending message: FORMATIVE/EMC.
- Feelings of sadness, anger, fear among victims: PSYCHIC/-SENSITIVE/HLC.
- Inability to concentrate for the victim: ANALYTICAL/HLC.
- Loneliness or isolation for the victim: SOCIAL/HLC.
- Hateful and violent messages: ETHICAL/EMC.
- Self-identity issues for both the bully and victim: PISTIC/HLC.
- Rule-breaking and codes of online conduct: JURIDICAL/HLC.

- Movement of the messages across electronic links: Kinematic/EMC.
- Embarrassing the victim in front of their friends: Social/HLC.
- Laws and regulation and their enforcement: Juridical/HLC.
- Distinguishing if a particular activity is considered bullying: Analytical/HLC.

Even with this rather cursory examination of another complex and unsolved problem involving computer use, we can see that the same aspectual richness and distinguishing of different human functionings that was helpful in addressing the procrastination problem will be able to bring depth and insight to an overview study of cyber bullying. HUCF existing research analysis can also be used to analyse and understand the contributing research fields, such as educational policy, educational technology, developmental psychology, counselling psychology, criminal justice studies, and others.

8.3 THE SECOND FINDING: THE HUCF HELPS UNCOVER HIDDEN ISSUES

The analyses performed in this thesis demonstrate that the HUCF is useful for uncovering "hidden aspects". This means finding things that are meaningful that were previously overlooked. Inherent in this definition is the observation that different people will tend to concentrate on certain aspects, overlooking others. An aspect that is overlooked by one researcher (or more often, one research community), may not be overlooked by others.

One response to this, when confronted with a complex situation in which little headway is being made, is to gather a number of people from various disciplines with different aspectual emphases, and to have them share with each other their own point of view, and to bring to bear their own insights. A main challenge of such inter-disciplinary discourse, however, is that the participants frequently lack a common language which would enable them to communicate clearly. When looking at challenges involving computer use, the HUCF can provide that.

In addition, even a single researcher or community of research can use the HUCF to prod them into recognising alternate or additional meaningful facets of the problem, helping to broaden their aspectual sensitivity. In so doing, it helps the dominant majority view to take other views into account.

- A typical information systems analysis of computer use often overlooks the BIOTIC aspect, focusing instead on ANALYTICAL, FORMATIVE and ECONOMIC issues. By doing so, it tends to overlook issues such as ergonomics.
- HCI researchers might be very attuned to BIOTIC ergonomics, and PSYCHIC/SENSITIVE perceptions of the interface, but not fully consider FORMATIVE issues such as will-power, or JURIDICAL and ETHICAL issues of what is due to each user, or how to go above and beyond in a spirit of generosity.
- Technology Acceptance Model (TAM) studies tend to concentrate on ECONOMIC return on investment, FORMATIVE performance, or ANALYTICAL distinguishing utility. They thus overlook SOCIAL and JURIDICAL questions, such as whether or not the goal of getting users to use the system is respectful and just.

In each case, the hidden aspects may have been previously discussed by others, but remain unexamined or ignored by groups of people who ought to be considering them. This finding is supported by the observations made in Chapter 7. Using Dooyeweerd's aspects (Section 7.2), recognising multiple necessary human functionings (Section 7.3) and recognising a multiplicity of relationships possible between these functionings (Section

7.5) are all ingredients that lead to the exploration of hidden issues.

This finding demonstrates that the HUCF could be of significant assistance to critical research approaches in IS. For example, Myers & Klein (2011) suggest that "rather than simply describing current beliefs and social practices, [critical research challenges] prevailing assumptions, beliefs, values and practices that are often taken for granted" (p 27). In order to do this, it must first understand what these assumptions and beliefs are; the HUCF can help to uncover these.

8.4 THE THIRD FINDING: THE ORIGINAL HUCF IS LIMITED, BUT CAN BE AMENDED

In the detailed overview of the HUCF in Chapter 3, several areas in which the HUCF is deficient were enumerated. These deficiencies need not render the HUCF unusable or unfixable. In describing the characteristics of a good Framework For Understanding (FFU), Basden suggests that a framework "should be open to extension, but in a way that is true to its nature, rather than by merely bolting new pieces on" (Basden, 2008, p. 14)

The most basic of the difficulties addressed in this thesis is the category of functioning of Engaging with Represented Content (ERC), in which the idea of *represented* content was found problematic. This was addressed by altering this category to be engaging with *meaningful* content. This change is significant, because it recognises that content need not be in the computer to be meaningful, as it is not the software itself which brings the meaning. Instead, it is the human user who brings meaning to the use of the program through their engagement with that content.

Discussion of the framework in Section 3.7 also found that the way in which the framework deals with normativity is not as rich as it could be. In particular, the framework relies on the Dooyeweerdian aspects for its normative basis, and appeals to the diverse norms that the aspects provide to lay a foundation for thinking normatively. This is an excellent foundation, and provides a helpful tool for thinking about how to design and use computer systems normatively.

However, by only analysing the normativity of each of the categories of functioning on its own, in terms of its aspectual functioning, it misses the richness of normativity that occurs within the relationship between the categories of functioning. The discussion in Section 3.7 provides some of this richness. In doing so, it extends the shalom principle from being only about shalom within the aspects to also being shalom within the various categories of functioning.

Finally, the framework in its original formulation does not provide a way to describe and reason about the varied responsibility (in both the sense of "duty" and also the literal sense of "ability to respond") of both the user and the original developer(s). Without this ability to assign duty and culpability to both the user and the developer, the need for and efficacy of alternate designs become more difficult to demonstrate. That is, without the recognition of shared responsibility for normativity, it is easy to slip into a dichotomy in which either the design of the software exercises absolute control over the running of the program and its impacts (a form of technological determinism) or else adopt a value-neutral view of technology in which the software is "just a tool; what matters is what you do with it."

The subject-by-proxy proposal introduced in Section 3.8 provides an intuitive mechanism by which the responsibility of the designer can be extended across space and time to play its role in the actual use of the computer by the user.

8.5 THE FOURTH FINDING: HUCF CAN HELP ALTER THE USER'S BEHAVIOUR IN USING THE SYSTEM

This finding comes out of a number of the analyses, but most prominently in the example of the grading spreadsheet and mail merge process, described in Section 5.1. The surprising observation made in that case is that the act of performing an HUCF primary analysis is itself a catalyst for introspection, assessment, and change. In the case of the emailed grade reports, performing the analysis led me to recall my commitment (PISTIC aspect) to be an instructor who goes "above and beyond" (ETHICAL aspect) and gives my students individual personal attention (SOCIAL aspect) in an attempt to build a class culture (FORMATIVE aspect) that fits with my vision (PISTIC aspect) for addressing my students as whole human beings, rather than just numbers in a spreadsheet.

However, in addition to simply forcing me to remember my commitment, as part of the analysis, it also gave me an opportunity to *recommit* to those values, while simultaneously showing me ways in which I could make that commitment concrete. For example, while doing the analysis, I realised that my method of communicating grade results, while efficient and providing meaningful feedback to most students about their performance in the course, did not help a couple of struggling students to gain insight into *why* they were not understanding a particular concept in the course. Although I performed the analysis only for the purpose of this PhD research, afterwards I also felt inclined to email one student an encouraging personal note about the challenges I've seen her overcome, and invite another out for coffee to discuss ways that we could help him to understand the concepts.

In my own head, I am committed to being a caring and giving professor who treats students with respect and dignity. I want to strive to help all students learn the material in my courses so they can be of service to others in their careers. However, all that is much easier said than done, and performing the analysis confronted me with the fact that I was not necessarily doing as well as I could. This reminder occurred in the context of a grading system that both helped me to give the students more regular feedback than they otherwise would have received, but also led to a detrimental attitude of "Well, I've sent out helpful grade reports that wouldn't have had to be sent; my work is done here."

In this case, the distinction between EMC and HLC also plays a role. Because the content is limited to the numerical data about the student performance in the course, most of the moral considerations only enter into the analysis when *engaging* with that content, bringing the meaning from the rest of my full human functioning with me into my engagement with the content. The student who recently had a grandparent pass away and the student who seems to be struggling with learning independent responsibility may get the same poor grade on an assignment, but may be best served by very different professorial responses. This distinction is meaningless in the numeric spreadsheet of grades itself, but can emerge in overall EMC functioning by the meaning I import to that engagement from my HLC functioning.

Other examples of this finding come from the other analyses that have been performed:

- In the procrastination example (Section 6.5), observing that the KINEMATIC ease of transitioning to the procrastinatory activity was a contributing factor in the procrastination, I searched for ways to increase the effort required to switch. In the case of the Yahtzee example, I added the network address of the website that hosted the Yahtzee game to my personal firewall software configuration, so that my web browser was prevented from accessing it. While it was always within my power to simply reconfigure the firewall to allow it again, the extra time and effort it would take to do so was frequently enough of a barrier to eliminate that game as a procrastinatory option.

- Also in the procrastination case, the observation that AESTHETICALLY, playing the Yahtzee game was ultimately dissatisfying was a surprise that occurred during the HUCF analysis, and led to a strongly renewed commitment to battling this waste of time with all of my energy and resources. The thought that "I'm wasting my time playing a game that ultimately isn't even very enjoyable" helped to "poison" the experience, and made it (and similar procrastinatory activities) easier to resist.
- Analysing the use of the Pandora online radio service (Section 4.5.1) was occasion for me to note just how much time I actually spent reading the biographies of the various musicians who perform the music being played. After having this ECONOMIC functioning called to my attention, I was able to see this as a waste of time, and curtailed this bad habit.
- Noticing the drudgery of exercising on an indoor machine (AESTHETIC HLC in Figure 7 in Section 5.4) encouraged me to explore outdoor jogging again, as it is more enjoyable (PSYCHIC/SENSITIVE) and beautiful (AESTHETIC) to be outdoors. I had switched to a low-impact stair climber at my local gym due to a sore knee some time ago, and got into the habit such that I stayed with that equipment even after my knee had healed. By switching back to outdoor jogging after doing the analysis, my workouts became more enjoyable, and thus more regular.
- Performing the HUCF analysis of using the F.Lux colour temperature software enabled me to see beyond the stated purpose for the software, which is to make the screen colours more visually appealing, and encouraged me to use the dimming evening colours as a catalyst to get to bed earlier in order to get a better night of sleep. (Of course, the reasons why I'd been staying up too late were not lim-

ited to only the bright lights from computer screens, and so making one small change did not make it instantly easy to alter a long-term bad habit, but did contribute towards addressing that habit.)

This finding is supported by the observations made in Chapter 7. The recognition of aspects (Section 7.2) and separate human functionings (Section 7.3) helps frame issues in a way that more clearly shows where, precisely, dysfunction is occurring and where it is having repercussions. It is the observation that each human functionings with computers and all of the later aspects within those functionings all have a built-in normativity (Section 7.4) that drives this opportunity for personal improvement in use. Thus, we can see that the use of the HUCF need not be limited to analysing situations objectively by external examiners, by can also be fruitful in aiding the user to examine their own personal use of computer subjectively, with an eye towards improving the overall human functioning with computers in their lives. It does this by enabling users to become self-critical in their own use, exposing overlooked aspects of use, and drawing attention to the "big picture" life issues, priorities, and values, which the computer use is presumed to serve in the first place.

The topic of changing your own behaviour is a perennial topic in popular self-help books. However, these books often suffer from a narrowness of approach, without fully considering the many interacting aspects of meaning. For example, in the book "Your Own Worst Enemy: Breaking the Habit of Adult Under-Achievement" (Christian, 2002), the author focuses almost exclusively on the FORMATIVE aspect of shaping your environment and exercising willpower to control the cues we give ourselves, and the PSYCHIC/SENSITIVE aspect of the feelings that result for our actions. Similarly, Seligman (2007), in "What you can change – and what you can't: The complete guide to successful self-improvement" concentrates mostly on the BIOTIC (neural chemistry), ANALYTIC (catastrophic thinking), and psychic/sensitive (fear, anger, depression) to the exclusion of others. By not examining the full range of human aspectual meaning, such approaches miss opportunities to motivate change and to envision normative human behaviour across the spectrum of human functioning. The HUCF can apply that, at least in situations involving computer use.

8.6 The fifth finding: HUCF can help better understand and appreciate existing approaches

The final finding, demonstrated in Section 6.6, is that when the technique of HUCF Existing Research Analysis is used, the insights and limitations of existing fields of research can be integrated and accounted for using the HUCF. This is powerful, because in the case of complex, deeply interdisciplinary problems, integrating a wide variety of existing approaches provides the only way to addressing these difficult issues.

By asking the questions "How does the HUCF see this area?", "How does it account for the insights?", and "How does it account for the limitations?", the framework is able to incorporate all of the insight from the various fields into a cohesive understanding of the problem, without "dumbing it down". One of the primary tools it uses to do this is a common language which can be used to state the insight and understanding from each area in ways that are understandable and comparable to the other areas. The HUCF Heatmap Visualization technique (see Figure 11) was used to aid in seeing the various ways in which each existing field could contribute to the cumulative understanding of the problem, and also to spot weak areas in which none of the fields are currently providing understanding where it is needed.

Finally, use of the HUCF can help each individual area by pointing out helpful directions they could go, or facets of their fields of research that are being overlooked. For example:

- In the field of HCI, we could see, in Section 6.6.2.3, that by under-emphasising the distinction between content and interface, the field tends to overlook problems like computer procrastination. It further suggests that the HCI's use of the concept of *affordances* appears a promising way to envision creative design changes that could ameliorate the problem.
- In the TAM research area, the HUCF analysis pointed out that TAM's emphasis on single application information systems in a workplace context created a blind spot for analysing the use of the computer to procrastinate. By being able to predict adoption of the original software, but not adoption of the procrastinatory activity, TAM is less useful than it could be.
- The HUCF also informed a critique of TAM's normative shortcomings, in terms of assuming that adoption of the software being investigated in a normative good to be sought, rather than providing tools to discuss whether or not the user's resistance to adoption should be championed or overcome.
- The use of the HUCF analysis brought into focus that TAM is based on the assumption that intentions will lead directly and deterministically to behaviour. The procrastination problem makes clear, in HLC/FORMATIVE functioning of the user, that the connection between intention and action is much more complicated than the TAM model allows for.
- The NWRIU research community can benefit from the HUCF analysis and the diverse normativity which the HUCF enables. This is because it was seen that NWRIU research assumes that some activities are appropriate for a workplace and others are not, but does not provide tools for discerning which is which. The varied normativities of provided by the HUCF, and in particular the norms of the

JURIDICAL aspect such as duty, fairness, and giving each their due, can help to provide this.

- The PIU community can benefit from the use of the HUCF in terms of investigating not only the psychological workings of their individual patients, but also the nature of the computer technology (such as the interface and the content) that feed the dysfunction of their patients.

This finding is supported by the observation (Section 7.6) that the HUCF was able to account for the insights and also the limitation in other fields' contributions to understanding computer procrastination. By doing this, a coherent integration of other streams of research became possible, in a way that respected the unique character of each of the existing fields. Thus we can see that analysis using the HUCF can not only help bring new understanding to current problems, but can also provide helpful affirmation, integration, and critique to existing bodies of research.

9 CONCLUSION

9.1 SUMMARY OF THE RESEARCH

This thesis has examined and assessed the Human Use of Computers Framework, originally proposed by Basden (2008). In Chapter 2, I reviewed other literature on frameworks in general, to show that Basden's use of that word is unique but commensurate with the way other researchers have used the concept of a framework for understanding. The second half of that chapter examined a number of existing approaches for understanding human use of computers, and briefly demonstrated that they each have deficiencies that prevent them from being able to fully address the complexity of actual human functioning when using a computer.

In chapter 3, I provided an in-depth introduction of Basden's Human Use of Computers Framework (HUCF), and discussed the ways in which it can be extended, improved, or more richly understood, such as how HCI, EMC, and HLC are defined and how they relate to one another. This chapter demonstrated that the framework holds great promise for providing insight and understanding into many computer use situations, but that it was largely untested. Chapter 4 then discussed what it means to test or assess a framework, and what forms such assessment can take, before introducing the methodology that this thesis would employ.

Chapters 5 and 6 are the results of this methodology, consisting primarily of various HUCF analyses. These analyses make up the primary data of the the thesis. Chapter 7 then extrapolated from those analyses a number of observations regarding the HUCF, and discussed the impact of these observations. These were made in support of the overall findings of the thesis, which were presented and argued in Chapter 8.

9.2 MEETING THE OBJECTIVES

Objective 1, "Show how use of the Human Use of Computers Framework can provide insight into the problem", is the most important of the objectives for answering the main research question. It was met primarily through the in-depth analysis of procrastination presented in Chapter 6. To demonstrate the well-rounded insight that can result from HUCF analysis, this chapter was formatted as a "PhD thesis in miniature", complete with its own literature review and findings, using HUCF analysis as the primary research method. The meeting of this objective was documented in the first finding in Section 8.2.

The second objective, "Show how other research approaches the problem and demonstrate that the available understanding is insufficient", was necessary for demonstrating that the chosen case study, computer procrastination, is problematic and academically interesting, and in need of new insight. This objective was met in Section 6.4, which reviewed five extant approaches for understanding computer procrastination, and demonstrated that the totality of the problem is not yet well understood or addressed.

Objective 3, "Show how the framework can constructively engage other areas of research", was met in Section 6.6, which accounted for the insights and the limitations of each of the existing research areas in terms of the HUCF. This was necessary, because an important claim of the HUCF is that it intended to augment and integrate existing approaches rather than replace them.

Finally, Objective 4, "Critique and improve the framework", was met in Chapter 3, where in addition to describing the framework, I also pointed out a difficulty with the ERC category and suggested a better approach (Section 3.4) and extended the framework to understand how normativity flows between the functionings (Section 3.6) and how it can flow between the developer and the user, mediated by the software artefact (Section 3.8). These extensions to the framework were put to use in the findings chapter (for example, in Section 8.2.2) when discussing the role of the developer and how the user can improve their own usage of the computer system.

9.3 LIMITATIONS AND FUTURE WORK

9.3.1 *Lack of empirical basis*

One of the main limitations of this research is that it does not use empirical methods but rather relies almost entirely on analysis, of both existing literature and of the researcher's subjective experience. Because the framework is a pre-theoretical device focused on everyday experience, this is an appropriate approach. The claim of the framework is that it can render the everyday use of computer systems more understandable, and thus the source of the experience being analysed is less crucial to testing the framework than the understanding that results. As long as the presented experience being analysed is sensible to the reader and has the ring of authenticity, it will provide a suitable source of experience for analysis. Nonetheless, the argument presented in this thesis would gain additional persuasive power by demonstrating the use of the framework by a larger number of subjects, each analysing their own computer use experience. Crafting such a gathering of data would require very careful experimental design. Because the framework provides insight into the meaningfulness of computer use as experienced by the user as well as the rest of society, it would be difficult to survey computer use analyses in a way that respected the legitimate subjectivity of each person's experience while also standardising and quantifying the results enough that they would be useful for statistical analysis. Having demonstrated the promise which the framework shows in this work, there is now motivation available to go to the next step of quantifying the impact possible by using the HUCF.

This critique of the work is particularly acute regarding the discussion of the flow of normativity between the human functionings (Section 3.7) and the flow of normativity between developer and user (Section 3.8). Both of these arguments are made almost entirely on the basis of thought-experiment and hypothetical examples. This need not be entirely inappropriate for a philosophical argument such as these, but empirical work demonstrating the practical efficacy of thinking in these terms would strengthen the argument. For example, an experiment could be performed to see if asking developers to think in terms of "Subject-by-proxy" made an appreciable difference in the level of responsibility they felt for the programs they created.

9.3.2 *Understanding of How to Test Frameworks*

There is surprisingly little research or discussion about what it means to test a framework. Rather, thinkers such as Kuhn (1996) and Mitcham (1994) tend to think of frameworks as something largely given and subliminal, and not in terms of a practical tool that can be assessed by how insightful it is when put to use. Other researchers were presented in Chapter 2 who have used the language of "framework for understanding", and have even presented tests of the frameworks they have developed, but have generally done so without much discussion of what such a test means.

Thus, a second limitation to the reliability of this thesis work is that the concept of framework-testing adopted in Chapter 4 may not be fully valid. While an argument was presented that assessing a framework is most convincing when performed by trying out the framework on a real-world situation, this argument is not a central focus of this thesis, and may be open to critique or refinement.

9.3.3 *Relationship to Basden's Other Frameworks For Understanding*

Basden's (2008) book develops a full suite of frameworks for understanding various issues related to computer use, including the HUCF examined in this thesis, but also frameworks for understanding the nature of computers, the development process by which programs are written, how knowledge can be represented internally, and the ecosystem in which computer use both affects and is affected by the larger societal context in which it occurs. These various frameworks were created using the same Dooyeweerdian foundation, and were intended to provide a big picture view of "the whole story that is information technology" (Basden, 2008, p. xii). Because this thesis was restricted in scope to only the HUCF, there is the possibility that fruitful synergy between the related frameworks has been overlooked.

For example, in understanding the procrastination problem, the larger context in which the procrastination occurs was largely in the background, mostly ignoring such issues as power relationships and the possibility that the procrastination may be a subconscious attempt by the user to "level the playing field" in a perceived conflict between the user and others who are interested in the results of their computing task. While such issues are nominally part of HLC functioning, connecting to Basden's framework for understanding IT as a full ecology may help to incorporate such concerns more organically.

Likewise, when discussing the sharing of responsibility for computer use between the user and the developer, discussion of Basden's framework for understanding information system development may have opened up additional avenues in which to pursue insight.

However, both of these examples are beyond the scope of this thesis, and are left as future work.

9.4 contributions of the findings

Chapter 8 contained a presentation of the findings of this thesis work. These are the contributions to original knowledge that this thesis makes. In this section, I discuss the impact of that new knowledge in a variety of areas.

9.4.1 *Contribution to Theory*

One of the unintentional contributions that this thesis has made came because of the discovery that there is almost no discussion of what it means to test or assess a pre-theoretical framework for understanding. This stems, in part, because of the unique conception of "framework for understanding" employed by Basden. Thus, in order to complete the research, some method of testing a framework needed to be developed. Because framework testing was not a central focus of the thesis, the method developed was sufficient for the needs of this thesis, but was not argued extensively or compared in depth to possible alternatives. Nonetheless, because of the relative paucity of existing approaches to considering the nature of a "framework for understanding", much of the discussion in Sections 2.2 and 4.1 may be of use as a starting point to other researchers who find themselves undertaking a similar task.

A second contribution to theory was made to the research into computer procrastination. The insights into understanding this phenomenon are detailed in Chapter 6. This includes providing research challenges to several of the extant areas which may have insight to contribute, in addition to a more solid description and explanation of the behaviour.

9.4.2 *Contribution to Methodology of Existing Research Areas*

One contribution of this research is the use of HUCF primary analysis as a tool for self-assessment in other research areas that wish to consider computer use. Researchers from each area can use the analysis to assess their own research interests, thus clarifying assumptions that they may be making implicitly.

For example, researchers from the Non-Work-Related Internet Use (NWRIU) research community could perform an HUCF analysis of their own research, in order to more firmly delineate where the exact boundaries lie of the phenomenon they are investigating. By doing this, they could more clearly see, in the FORMATIVE/HLC for example, the assumptions that they are making about the nature of voluntariness on the part of employees. This would give them an opportunity to either expand the scope of their research to include involuntary behaviour, or to explicitly exclude unwanted procrastination from their scope of interest.

Likewise, a field such as Technology Acceptance Model (TAM) may be able to use the HUCF as a tool for self-assessing possible blind spots, and may find it useful for understanding *why* users find some software products more useful than others. In a commentary on the development of TAM research, Benbasat & Barki (2007) lament a lack of understanding what makes a system useful, suggesting that one reason is that "opening the black box of usefulness is neither straightforward nor trivial" (p.214). This is because the usefulness of a software application does not emerge from thin air, but from interacting with the content. By providing researchers with a tool for considering human engagement with computers that distinguishes interface from content from impact, the HUCF can point to new directions for research.

Other research areas which examine computer use can likewise benefit from using the HUCF to highlight which aspects of the issue they cover well, and which they may be overlooking. Because there is always a certain level of subjectivity is inherent in the HUCF analyses, having experienced researchers and practitioners from each discipline perform their own HUCF analysis would lead to results that are more meaningful and helpful than the analyses offered in Section 6.6, which were created from the perspective of an outsider to these fields. By providing a conceptual tool by which the insiders to the field can self-assess their own approach to understanding computer use, this thesis provides an additional methodological tool for any field that involves humans using computers as part of its area of inquiry.

9.4.3 *Contributions to Practice*

This work contributes practice in a number of ways. First, and most fundamentally, it has demonstrated the practical efficacy of a tool that can provide insight and understanding into computer use situations. This is of interest to a wide range of researchers and professionals for whom such understanding is a crucial objective. For example, by analysing the use of a new computer system using the HUCF before it is rolled out to the users, a manager may gain practical insight into likely issues and potential dysfunctions, and take steps to ameliorate these. Likewise, a researcher examining a complex and difficult computer-related phenomenon – cyberbullying, software piracy, various social media pathologies, or online shopping behaviours, for example – can gain insight into areas of the problem may have been previously overlooked, and which merit further investigation.

Second, this research has also demonstrated techniques that can be used at design time for creating a more normative computing environment. The software developer can utilise the HUCF analysis tools to more thoughtfully predict the issues that the user will encounter during use. In particular, the developer can look for areas where designer-driven change is possible by paying attention to which functionality in the HCI and EMC functioning affects or creates the possibility for the various HLC functionings. Because the HCI and EMC functioning are at least somewhat delineated by the developer at design time, attention can be focused on those areas in which the developer holds primary control over how the system will be used.

Finally, this research has provided a tool for introspection and self-assessment by the user. As seen in Section 8.5, the simple act of performing an HUCF primary analysis (Section 4.5.1) becomes an occasion for the computer user to consider the normativity and consequences of their use in a wide diversity of aspects. Frequently, at least some of this functioning will have previously been hidden or undetected by the user, and bringing all of these issues to light can form an important opportunity for improving their own use of the computer. One example of how to exploit this possibility might include a company providing training in HUCF primary analysis as part of regularly implemented employee training sessions when a new software product is rolled out in a company. As the aspects are intuitively recognized rather than theoretically understood (see Section 4.5.1), this training need not be long or complicated to begin producing useful results. Likewise, individual computer users can use this tool to evaluate their computer use at home to help identify qualities of it that are not bringing as much advantage into their lives as it could.

9.4.4 *Contribution to Philosophy*

Finally, this research presents a challenge to the community of Dooyeweerdian philosophy. The standard Dooyeweerdian ontology divides functioning for any entity into aspects in which that entity is subject to the laws/norms for that aspect, and those in which it is not subject, but can function as an object. (For example, Dooyeweerd would suggest that a tree, as a living being, is subject to the laws of the QUANTITATIVE through BIOTIC aspects, but can only function as an object in the rest of the aspects: A tree can be PSYCHICALLY perceived by others, FORMATIVELY shaped by a carpenter, AESTHETICALLY beautiful, or JURIDICALLY owned. In each of these cases, the tree is an object of aspectual functioning, but not the subject.)

However, while this ontology may be valid and consistent, it is not always *helpful*. In the discussion of users, developers, computers, and responsibility (Section 3.8), it became clear that although it is ultimately the developer who holds responsibility for how the computer system is shaped, and thus partial responsibility for how it is used, it quickly becomes clumsy to consider how that responsibility is exercised across the distance in time and space between the actions that produce the artefact, and the use of that artefact. The proposal of the "Subject-by-proxy" mechanism solves this problem without stripping any responsibility from either the developer or the user.

By showing that there is a detriment to a strict adherence to Dooyeweerd's original ontology, and that there is a simple and effective workaround for this detriment, this research contributes a richer understanding of subject/object functioning for inanimate objects to the Dooyeweerdian community.

In the same way, other philosophical approaches which rely on considerations of subject and object functioning may also benefit from this discussion. For example, Descartes sharply distinguished subject from object in declaring the human self as the ultimate subject, setting it over against the objects of one's perception. Heidegger, in response, concentrated instead on his notion of "Being" in which subject- and object-functioning become blurred. Likewise, Latour, in articulating the model of Actor-Network Theory, also does away with the distinction between human subjects and non-human objects, instead examining a heterogeneous set of associations amongst humans and non-human "actants" (Latour, 1999). The notion of Subject-by-proxy may be insightful for these approaches as well, by demonstrating a way of keeping the distinction between subject and object, while also recognising that non-human entities can and do externally behave in a way that we associate with subjectivity.

9.5 DIVERSITY OF HUMAN FLOURISHING WITH COMPUTERS

We can now return briefly to the significant diversity of issues that come up when considering fully a single instance of computer use, as seen in Section 1.3, which discussed a hypothetical scenario of a graphics designer creating an advertisement at her computer. Rather than facing a chaotic pile of separate issues, the use of the HUCF allows us to see all of these separate functionings as part of an integrated whole. By seeing how the HCI, EMC, and HLC functioning are distinct but related, and how each includes human functioning in all 15 aspects, the diversity of experience is respected and maintained, while also allowing a "big picture" to emerge in which each issue can be seen in relation to the others.

By providing a detailed overview, the HUCF can help both users and designers create and use computer systems in a way that fully supports the large-view goals and ambitions of the users. Because of the diverse normativity in the framework, use of the framework can point to previously overlooked avenues in which human flourishing can be enhanced, and it has also been demonstrated to be useful in detecting, analysing, and addressing dysfunction when it occurs in computer use.

By providing a systematic and transparent technique for understanding, evaluating and critiquing computer use situations, the framework provides a key tool in helping computer technology play a beneficial role in human living. Increasing productivity and efficiency, freeing us from many kinds of drudgery, providing stimulating and enjoyable recreations, and opening up possibilities for collaboration and social exchange are all avenues by which the computer can improve the human condition. By being intentional and normative about shaping our computer use, we be able to protect the dignity of our humanness, staying fully human while exploiting the extraordinary capabilities of computer systems to enhance our lives.

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