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Keywords

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

Disciplines

Computer Sciences | Philosophy

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Understanding of Computers and Procrastination: A Philosophical Approach

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Abstract

Computer procrastination is a complex problem that is under-researched. After identifying a number of key characteristics of it, we survey five existing fields of research that may contribute insights into this interdisciplinary problem, and demonstrate that none of these areas can provide satisfactory insight on their own. A philosophical framework for understanding computer use is introduced, and applied to a case study to demonstrate its potential in understanding the richness of computer procrastination. We then show how this framework can reveal the ways in which each of the existing fields is limited in its ability. The result is both an understanding of why existing research has not directly addressed this issue, and suggestions for a way forward for further research into computer procrastination.

Keywords: Computer procrastination; Philosophical framework;

1. Introduction

While working on a short blog entry related to your research, you became frustrated about your research progress. Feeling unengaged in the blog writing, you switch to a new browser window to do a quick search on a related topic. As long as you have the browser open, however, you navigate to a game site and play an online version of the old dice game Yahtzee. An hour later, you are still playing, trying to better your high-score, and feel guilty about the waste of time. No matter how mightily you steel your will to the contrary, and no matter the feelings of guilt and stress that

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result, this kind of online procrastination continually sneaks into your life and disrupts your productivity.

There seems to be something about computer technology and internet connectivity that distracts us, that tempts us towards computer procrastination (Lavoie & Pychyl, 2001). This tendency is evidenced by personal experience and by anecdotal evidence (Klosowski, 2012) (Johnson, 2011) (Mnookin, 2007). For a tool widely perceived to enhance our productivity in many areas of life, this is remarkable. However, there has been very little academic research into this phenomenon. Non-computer-specific 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?

The purpose of this paper is to propose and explain a framework for understanding computer procrastination, and to show that framework in action and demonstrate its ability to provide insight into complex problems. In this sense of use, "frameworks for understanding" are what enable thinkers to generate theories (Mitcham, 1994, pg 154), so such a framework can lay the groundwork for future attempts to explore the nature of computer procrastination.

Frameworks are tested in a different way from theories. Whereas theories may be deemed true or false, frameworks are fruitful or fruitless, useful or useless. So, in attempting to address the above questions, this paper takes the form of a review of several fields of research, followed by argument, rather than that of empirical research.

Section 2 identifies a number of characteristics of computer procrastination, some of which it shares with non-computer procrastination. Section 3 contains an overview of some of the areas of research which may have insight to contribute to the problem, but shows that none are able to address computer procrastination fully. Section 4 introduces a new approach to understanding computer procrastination, based on a novel philosophical framework, and demonstrates how this framework might be able to address computer procrastination, thus providing an answer to Question 2. Section 5 revisits each of the other areas of research, using the framework to reveal why each is not able to address computer procrastination, thus addressing Question 1. Finally, Section 6 summarizes the contributions this research can make to a wide variety of areas.

2. Characteristics of the Procrastination Problem

Procrastination has been defined in a variety of ways in the literature, as summarized in Table 1. In this section, we analyse these definitions to generate a

list of characteristics we'll need to consider in order to be able to address the problem.

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 through indecision, when early action would have been preferable” (2012). The word ‘dilatoriness’ has strong connotations of procrastination being problematic. Even though occasionally the procrastination might prove beneficial, there is at least an expectation of detrimental outcome, and/or a feeling of guilt. Lay’s (1986) definition of procrastination as “the tendency to put off that which is necessary to reach some goal” emphasizes the delay, while lacking any sort of normative element. Ferrari, drawing on Solomon & Rothblum (1984), alludes to an evaluative element when he uses a definition of “the purposive delay in beginning or completing a task to the point of experiencing subjective discomfort”(Ferrari, 1992, pg 98). Several researchers strengthen this normative element by including the notion of “ought” in their definition: Andreou (2007, pg 183) suggests that procrastination involves “delaying in which one leaves too late or puts off indefinitely what one should – relative to one’s ends and information – have done sooner”. Silver and Sabini (1981) suggest that in true procrastination, a behaviour must be irrational, relative to what the procrastinator ‘ought’ to be doing. Gjelsvik (2010) explains that procrastination occurs when the procrastinators recognize, or at least ought to recognize, that the benefits of prompt action outweigh the benefits of delay, but delay nonetheless. For the purposes of this paper, we accept Steel’s (2007, pg 66) definition of procrastination, which efficiently combines a number of elements from other researchers: “to voluntarily delay an intended course of action despite expecting to be worse off for the delay.”

However, all of these definitions are for generic procrastination, not computer procrastination. Unfortunately, extant literature contains no definition of computer-related 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 elements are adopted: First, in computer procrastination, both the original intended task and the procrastinatory activity take place using a computing device, and second, we explicitly recognize that such procrastination can occur not only in the workplace, but at home and on the move, using personal computers, tablet devices, and smart phones. The later is important, because other research tends to focus exclusively on workplace computer use.

Reference	Definition
Oxford English Dictionary(2012)	“The action or habit of postponing or putting something off; delay, dilatoriness. Often with the sense of deferring through indecision, when early action would have been preferable.”
Lay (1986)	“The tendency to put off that which is necessary to reach some goal.”
Soloman & Rothblum (1984)	“The act of needlessly delaying tasks to the point of experiencing subjective discomfort.”
Andreou (2007)	“Delaying in which one leaves too late or puts off indefinitely what one should – relative to one’s ends and information – have done sooner.”
Silver & Sabini (1981)	“A procrastinator is 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.” “A person is procrastinating if (s)he is irrationally putting off, and if this irrationality is caused by recognizing ... what (s)he ought to be doing.”
Gjelsvik (2010)	“Procrastination is delaying an action for no good reason.”
Steel (2007)	Procrastination is “to voluntarily delay an intended course of action despite expecting to be worse off for the delay.”

Table 1: Varying definitions of procrastination

Thus, in this article, the particular kind of procrastination we're interested in has several characteristics:

1. both intended and procrastinatory activities using the computer
2. voluntary delay of intended task by performing some other activity using the computer
3. irrational excuses or self-deception
4. a normative perception of being worse off
5. can take place anywhere, not just the workplace.

Having clarified the characteristics of the phenomenon we're interested in, we will now use these characteristics to demonstrate that other research areas cannot comprehensively address the full problem of computer procrastination.

3. Existing Research Relevant to Computer Procrastination

There are a number of research areas where we might expect that computer procrastination would be studied, but this is not the case. We look at five areas here, in which some research has been done that is relevant to the issue, and show that none is able to adequately address the whole issue. Reasons for this deficiency are discussed later.

3.1. Computer Procrastination and Psychology

In Steel's 2007 large meta-analysis of 250 peer-reviewed articles on procrastination, the vast majority are from within psychology or one of its sub-fields. Thus the field of psychology seems a natural starting point for studying this issue. Research in psychology has studied procrastination from a number of angles. Findings have correlated procrastination with a number of personality traits, including:

- 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)
- Feelings of
 - anxiety (Rothblum et al., 1986; van Eerde, 2003)
 - depression (van Eerde, 2003)
 - frustration (Blunt & Pychyl, 2000)

- stress (Tice & Baumeister, 1997)
- guilt (Fee & Tangney, 2000; Pychyl et al., 2000);

Research in psychology has also identified the characteristics of tasks most likely to be procrastinated on, such as:

- Task aversiveness (Kachgal et al., 2001; Peterson, 1987)
- Timing (in which procrastination is more likely to occur when the reward is distant and/or the aversiveness is near) (Schouwenburg & Groenewoud, 2001; O'Donoghue & Rabin, 1999; Strongman & Burt, 2000)
- Boredom (Vodanovich & Rupp, 1999)

Such findings might provide a context in which we can begin to ask why the computer would make procrastination a particularly tempting option. However, very few articles in the psychology literature have discussed computer procrastination. Rather, they discuss procrastination in its generic, non-computer-specific sense.

Only one psychological study has directly examined the particular connection between procrastination and internet use. Lavoie and Pychyl (2001) collected data using a voluntary online survey. Over half of the respondents indicated regular, significant procrastination was a problem when they were online, with 47% of online time reported to be procrastinatory in nature. That this single study represents the entire psychological study of the specific problem of computer procrastination seems a surprising hole in the research literature.

Though psychology studies generic, non-computer procrastination, it can not do full justice to computer procrastination. Of the five characteristics identified in Section 2, psychology can address irrationality and delay, but normativity and the fact that it takes place using a computer are meaningless to it. This makes it difficult for psychology to generate questions for research that are fully meaningful within the field of computer procrastination.

3.2. *Human-Computer Interaction*

Computer procrastination obviously only arises when a human interacts with a computer, so one might expect the field of Human-Computer Interaction (HCI) would study this. Research in Human-Computer Interaction is interdisciplinary and multifaceted, embracing ergonomics, sensorimotor channels, interface objects, user-computer dialogue structure, proximal interfaces, affordance, cognitive dimensions, and much more (Carroll, 2013; Dix et al., 2004; Greeno, 1994; Norman, 1999), and also affective computing (Zeng et al., 2009; Hudlicka, 2003; Rothblum et al., 1986; van Eerde, 2003) and attention-aware computing (Bailey & Konstan, 2006). Many of these are potentially relevant to

computer procrastination, and some research investigates the use of information and communication technology to reduce procrastination in general (Davis & Abbitt, 2013). However, no articles which address the specific problem of computer-related procrastination within this field of study could be found by the authors.

It may be that HCI research has a blind spot, because it has traditionally been applied, not to everyday problems like procrastination, but to professional and academic issues and contexts.

Of the five factors identified in Section 2, HCI can obviously address the fact that the activity is performed on the computer, and can begin to explore how that might lead towards procrastination by highlighting, for example, the ease of switching between tasks. However, the idea that to do so is detrimental and constitutes an irrational delay are factors that are meaningless to it. This makes it difficult for HCI researchers to formulate research questions that are fully germane to computer procrastination.

3.3. *Technology Acceptance Model*

Davis' (1989) Technology Acceptance Model (TAM) is a powerfully predictive theory for understanding whether and why a new software product will be accepted and used by the user community (Lee et al., 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 et al., 2003) to be helpful in understanding the behaviour. TAM is an approach that recognizes impact on the life of users as well as interaction with the computer, by addressing Intention to Use, and by distinguishing Perceived Usefulness (PU) from Perceived Ease of Use (PEoU).

At first sight, it might seem that TAM is able to address most of the factors identified in Section 2. Intention to Use would seem very relevant to computer procrastination, and PU to delay and waste of time. The importance given to perceived usefulness suggests it can cover the idea of the procrastinator perceiving themselves to be worse off. TAM allows PU to be compiled from many external variables, including, for example, enjoyment (Teo et al., 1999), so in principle it could include factors like irrational excuses and delay. PEoU could address ease of switching from the intended to the procrastinatory task.

However, TAM does not address computer procrastination very well. The notion of usefulness, as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989), is difficult to square with the dysfunctional nature of computer procrastination. Procrastination takes place *despite* the user's knowledge that they will be worse off for the delay. TAM presupposes a professional context of use, while computer procrastination occurs anywhere. To combine several important elements of computer procrastination into PU makes TAM a very blunt instrument. Being predictive rather than prescriptive, TAM doesn't provide any guidance on

questions on questions of *ought*, but begins with the simple assumption that the use of the system is an appropriate goal. It treats user resistance as something to be overcome (Hirschheim, 2007), whereas in computer procrastination, resistance to the temptation is something to be welcomed. Thus TAM's normativity is the wrong way around.

TAM generally assumes a single main application with a movement of attention towards it. Procrastination, however, usually involves a movement of attention away, towards alternate applications. In this way, TAM's capacity to explain computer use actually misleads us when dealing with multiple applications, competing for attention. TAM's foundation on the Theory of Reasoned Action (Fishbein & Ajzen, 1975) and the Theory of Planned Behaviour (Ajzen, 1991) makes it difficult to address the irrational tendency. TAM's focus on the user's intention is irrelevant precisely because in procrastination the person is acting contrary to their intentions in the first place.

3.4. *Non-work-related Internet Use*

Research into non-work-related internet use (NWRIU), "wasting time online", recognizes the potential for "anti-productive tendencies in the computer, such as cyberslacking or cyberloafing" (Blanchard & Henle, 2008; Lim, 2002). It is studied in business and organizational psychology and is a growing field, drawing on the existing body of research on workplace deviance. A number of psychological and organizational factors have been correlated with increased NWRIU:

- Perceptions of unfair treatment (Blau et al., 2006; Lim, 2002)
- Perceptions that co-workers' and institutional norms allow it (Blanchard & Henle, 2008; Liberman et al., 2011)
- External locus of control (Blau et al., 2006; Blanchard & Henle, 2008)
- Gender, youth, and minority status (Vitak et al., 2011)
- Computer experience, and associated optimism about computer use (Garrett & Danziger, 2008; Vitak et al., 2011).

This research area 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. However, it does not cover all five factors:

First, it addresses use in the workplace, undertaken by employees, whereas procrastination can occur anywhere by anyone.

Second, the field appears to implicitly accept that every action of the employee is under their direct, conscious, voluntary control, as in "the individual's decision to engage in personal online activities at work" (Garrett & Danziger,

2008, pg 949). Much NWRIU research assumes an element of rational choice, such as maintaining a mental ledger of effort and reward (Lim, 2002) or the simple calculation of expected outcome (Garrett & Danziger, 2008). Procrastination, however, is irrational and often not under conscious control. In some NWRIU research, the discourse is in terms of employees intentionally sabotaging their productivity, ignoring the possibility that the user earnestly wishes to be more productive but cannot help themselves.

Third, this field fails to address what it is about the technology that encourages procrastination.

Fourth, the normative basis of NWRIU research, for determining whether or not a given use of the internet is appropriate, is weak. For example, Blanchard and Henle's (2008) distinction between serious and minor cyberloafing begs the question of how serious is distinguished from minor, and how normativity depends on context (e.g. workplace versus home). It ignores the question of what kinds of activities actually *ought* to be acceptable.

3.5. Problematic Internet Use

The field of problematic internet use (PIU) considers situations in which excessive computer use descends into dysfunction and pathology (Young & de Abreu, 2011). "PIU is a multidimensional syndrome that consists of cognitive, emotional, and behavioural symptoms that result in difficulties with managing one's offline life" (Caplan et al., 2009). PIU often includes some of the symptoms of an addiction (Greenfield, 2011; Yellowlees & Marks, 2007), with the user spending such large amounts of time and energy online that virtually every other area of their life begins to suffer, and often coincides with other pathologies such as loneliness, depression, isolation, and risk-taking behaviours (Davis et al., 2002). The issue has been studied with emphasis on its role among university undergraduates (Frangos et al., 2011), in the office (Thatcher et al., 2008), among game players (Caplan et al., 2009), or for pre-employment screening (Davis et al., 2002). Some studies concentrate on the causes of the problem (Greenfield, 2011; Shi et al., 2011; Young et al., 2011), some on the impact on the individual users' lives (Caplan et al., 2009; Frangos et al., 2011), and some on approaches to helping those who suffer from this dysfunction (Geranios, 2009; de Abreu & Góes, 2011; Beard, 2011).

Thus PIU might contribute an understanding especially of the normativity of computer procrastination, and some aspects of irrational excuses and non-workplace use. However, it has limitations. A given behaviour only falls under the purview of this research when the dysfunction has become so intense and usually of long duration that it must be considered abnormal (addiction), and requires clinical intervention. Our concern, however, is not with this rare (though serious) problem, but is rather with the common, everyday experience of relatively short delays that many people have when using computers.

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

Table 2: Summary of other research areas' ability to address main issues in computer procrastination

The literature in this field amply demonstrates that computer technology has the capacity, in some circumstances, to shape us in involuntary ways but does not much discuss this. PIU research commonly focuses on characteristics of the user that causes such major dysfunction, whereas it may be the characteristics of the technology that tempt otherwise healthy people to procrastination.

3.6. Summary of Other Research Areas

Table 2 summarises the above discussion, showing to what extent each area of research might provide insight into each of the six factors identified above as important in computer procrastination. Each '+' indicates a better contribution, while a '-' indicates that the assumptions made in the area might actively mislead.

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? As defined in Section 1, a framework for understanding is what enables thinkers to generate theories. The existing ways of approaching the problem have proven inadequate, so a new 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.

Could these five characteristics constitute a framework for understanding computer procrastination? This is unlikely, because they lack a systematic empirical basis and there might be other characteristics. They were derived by analysing definitions of ordinary procrastination and adding reflection from the authors' experience. The purpose of introducing the five characteristics was merely to show that there is a problem to which the two questions are addressed. To find a sound framework in the absence of any empirically tested set of characteristics of computer procrastination, it is wise to fall back on an understanding of general computer use, of which computer procrastination is one instance. Such an understanding is rooted in philosophy.

4. A New Framework

Philosophy, which seeks to find and explain the coherence between various fields of understanding (Strauss, 2009), can help us examine the problem of computer procrastination, because it gives a wider view. It can be a very practical tool that enables disparate research areas to be seen as part of a broader picture, which is what is needed here. Philosophy is not used directly, but rather is used to formulate an integrated philosophical framework for understanding computer use that is intended to apply to any context. Such frameworks can point to previously under-studied areas and prompt us to ask important, new questions.

This paper employs a philosophical framework developed from the multi-aspectual philosophy of the 20th century Dutch philosopher Herman Dooyeweerd (Dooyeweerd, 1955). Basden (2008) shows how Dooyeweerd's philosophy can provide new approaches in several areas of research, with chapter IV devoted to a new way of understanding computer use. This framework has the potential to address all five of the characteristics identified above, in an integrated manner. The first subsection explains the framework and part of Dooyeweerd's philosophy. The following subsections show a case study to illustrate how it might be used and discuss its application. The final subsection discusses its ability to address the five characteristics.

4.1. Basden's HUC Framework

The main attraction of Dooyeweerd's thought is that it is deeply non-reductionist, with the strong claim that reality is meaningful in a wide variety of 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

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 (Dooyeweerd, 1955). Each aspect provides a distinct set of laws that enable functioning in that aspect and different kinds of repercussion to occur. To Dooyeweerd, all human activity consists of functioning in all aspects simultaneously.

Each set of laws implies a different kind of normativity; for example, the ANALYTICAL normativity of being rational, 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.

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 procrastination, such as delay and irrationality, and to provide various ways of understanding "worse off". 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 life.

In applying Dooyeweerd's aspects to understanding human use of computers, as the HUC framework, Basden (2008) differentiated three distinct types of entity with which humans interact when using a computer.

Human/Computer Interaction (HCI) To use a computer, we must interact with the computer itself, both with the hardware and with the user interface portions of the software.

Engaging with Meaningful Content (EMC) Computer programs represent content we engage with that is meaningful to us. For example, when we use an email program, it is not the internal voltages inside the CPU or the glowing of pixels on the screen that have direct meaning in our lives, but

rather the content of the email messages and the information that they carry.

Human Living with Computers (HLC) The use of the computer plays out in our everyday lives; its effects escape the “box that is the computer” and affect things “out here” in our lived reality.

These three interactions or engagements and the fifteen aspects may be seen as two dimensions of a framework with which to understand computer use in general and procrastination in particular. This is illustrated in the following case study.

4.2. An Illustration

The following example illustrates the use of the framework in understanding procrastination, using the vignette with which the article began. In Yahtzee, the player clicks to roll virtual dice, must choose to keep some dice rolls and rethrow others in an attempt to maximize the end score. An actual scenario of the authors is analysed, revealing how each of HCI, EMC and HLC are involved, and how almost every aspect is meaningful.

Table 3: Example of Framework in Action

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
Physical	Forces required to move mouse, press buttons		Sitting still, very low energy expenditure
Biotic		Dead game; no sense of flourishing	Tense muscles, strained eyes from quick playing

Table 3: Example of Framework in Action

Aspects	HCI (Human/Computer Interaction)	EMC (Engaging with Meaningful Content)	HLC (Human Living with Computers)
Psychic / Sensitive (Perception, feelings, emotions)	Visual perception of the screen Tactile perception of the mouse	Feelings of pleasure, enjoyment, “mindless diversion”	Anxiety(Kalwar et al., 2012), frustration(Bessièrè et al., 2006), and the feelings of guilt and stress from not getting things done; e.g. “I don’t feel like doing this”
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
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 Planning where to place dice throws	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 (Talbot, 1995)
Lingual (Symbolic meaning)	Simple, clear pictorial symbols allow easy interaction	Dice and score card have numeric and game-play significance	
Social		<i>Yahtzee</i> 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 3: Example of Framework in Action

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 <i>fun</i> .	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-centred; 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	Breaking faith with those who expect updated blog content, and with myself.

This demonstrates how the 15 modal aspects are meaningful simultaneously in many different ways, and shows the distinctions between HCI, EMC, and HLC. It also demonstrates how procrastination results from the interplay between them.

Figure 1 shows Table 3 intuitively interpreted as a shaded heat map, with darker shades indicating greater significance.

4.3. Analysis

4.3.1. Analysis of the Table and Heatmap

From this, a number of things stand out, most of which can be reasonably generalised across different applications. First, notice how many aspects are in-

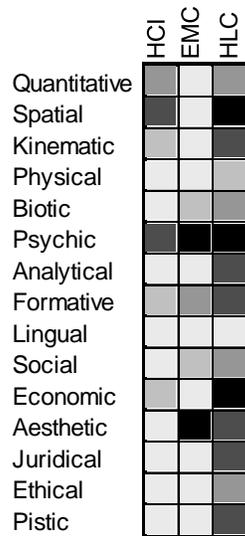


Figure 1: Heat map diagram of computer and internet procrastination using HUC framework

involved in computer procrastination, and the wide diversity of factors that are meaningful to it.

Second, in HCI functioning, two aspects seem most important: the SPATIAL and the PSYCHIC/SENSITIVE. The SPATIAL is important because of the proximity of the tempting application on the screen, perhaps along with the KINEMATIC of mouse movement. The PSYCHIC/SENSITIVE is important in that it is via the senses that we interact with the computer. The QUANTITATIVE aspect is also important in that computer procrastination would be far less likely to occur if there were not a number of applications available. The later aspects of HCI play less part, and are likely to vary across situations.

Third, EMC functioning, by its very nature, will depend almost entirely on the kind of application used for procrastinating, because how we engage with the content of the program depends significantly on the nature of that content. However, two aspects of EMC stand out, and it is reasonable to generalise this. Applications that, in their content, result in strong feelings (PSYCHIC/SENSITIVE aspect) and fun (AESTHETIC) will be more tempting as procrastinatory activities than others.

Fourth, we see that it is in the HLC functioning that most aspects of computer procrastination are important. It is the ECONOMIC aspect of HLC, in wasting time, that is the presenting problem, which results in feelings of guilt (PSYCHIC/SENSITIVE and JURIDICAL aspects). It also involves self-deception and breaking faith with regard to commitments (PISTIC). Two AESTHETIC functionings may be seen, in that the original activity was boring, while the pro-

crastinatory activity, which seemed to be fun when engaging with the content, is often, in life, ultimately unsatisfying. The *FORMATIVE* aspect is present in two ways, as a result of (lack of) achievement of anything worthwhile, and as part of what enables procrastination, namely lack of willpower. Also, without the *SPATIAL* and *KINEMATIC* aspect, that the user does not have to get up and walk to the procrastinatory activity, procrastination would be less likely. The *ANALYTICAL* aspect is present in rationalizations.

Fifth, notice the interplay between earlier and later aspects: One of the later aspects, *AESTHETIC* boredom in life, provides the leading motivation, the expectation of *AESTHETIC* fun in EMC provides the attraction and the earlier aspects of both HCI and HLC makes it easy to follow this attraction, then the results are mainly in the later aspects of HLC.

Most of the above observations do not depend on the particular application. What varies between applications is the details of the HCI and the detailed content of the EMC, but not the fact that the content is attractive.

4.3.2. Observations about the Framework

This analysis demonstrates that the framework may be fruitful in addressing the as-yet-unaddressed complex problem of computer procrastination. Recall from Section 1 that fruitfulness is the test for frameworks.

There are two dimensions to the potential richness of this framework. First, it enables us to separate out conceptually three human engagements, with technology (HCI), with information (EMC) and with life (HLC), without divorcing them from each other: HCI enables EMC, which is used in life (HLC), and all three together constitute the user's experience of Information System (IS) use.

Second, from the diversity of aspects found in this case of a relatively simple procrastinatory application, it is reasonable to believe that we should expect many aspects of each of HCI, EMC and HLC to play some part in the phenomenon of computer procrastination. Hence, to understand the phenomenon of computer procrastination, in principle all aspects need to be taken into account. Some aspects are important in all three columns, for example the *PSYCHIC/SENSITIVE* aspect, while some aspects are mainly in one, such as the *ECONOMIC* aspect.

4.4. On the Potential of the Framework to Understand Computer Procrastination

The five characteristics identified as important during computer procrastination may be addressed by the above framework as follows:

Activities using the computer: Basden's(2008) HUC framework provides a basis for separating out, recognising and studying the relationships between:

- the user's interaction with the computer (HCI), which can explain ease of switching

- the user's engagement with attractive, interesting content of the alternative application (EMC)
- its place in life, which accounts for waste and feelings of guilt (HLC).

This is specific to computer procrastination, and gives shape to the remaining characteristics, some of which are shared with other procrastination.

Delay: Delay is meaningful within HLC; to HCI and EMC, it is merely a passing of time. What makes delay meaningful is the PSYCHIC / SENSITIVE aspect, since we feel delay, and the FORMATIVE aspect since delay presupposes a purpose.

Irrational excuses: The irrationality is part of the user's life, hence comes under HLC rather than EMC or HCI. It is an ANALYTIC aspect of HLC.

A normative element of being worse off: Each aspect differentiates benefit from detriment naturally. To say procrastination is detrimental is mainly meaningful within HLC, and in certain aspects: ECONOMIC aspect (waste of time), FORMATIVE (lack of achievement), AESTHETIC (dissatisfaction) and PISTIC (self-deception and breaking of trust). The irrationality is relative to what 'ought' to be done, a JURIDICAL problem.

Anywhere, not just the workplace: Dooyeweerd's aspects were intended to apply to all human activity and everyday life, including but not restricted to, professional work or academic activity. So are Basden's (2008) three engagements. The HUC framework, therefore, is able to support studies of computer procrastination of all kinds.

Thus the HUC framework provides a paradigmatic foundation for addressing all of the five characteristics, in a way that the individual research areas cannot. However it can go further in four ways:

The HUC framework may be used for critique. Critique may be made by reference to either aspects or the three HUC engagements. As the next section demonstrates, it can be used to evaluate research in existing areas. It can also be used to critique the five characteristics of computer procrastination suggested in Section 2. Critique by aspects asks whether there are any aspects that are missed (such as the lingual and ethical) and investigating whether those aspects are important. Critique by the engagements draws to our attention that the list contains no characteristics specifically related to EMC or HCI. This should motivate investigation of whether there is anything in these that is essential in computer procrastination.

The second development, which can follow from critique, is to identify new characteristics of computer procrastination. Considering EMC, for example,

suggests that the attractiveness of the tempting application is important. Considering HCI points out the importance of ease of switching applications. Currently these two elements are conflated into the first characteristic, but the HUC framework suggests they should be separated out.

The third development is to use the HUC framework to suggest ways to test other suggested computer procrastination characteristics for their ability to contribute insight and understanding.

The fourth development is that the HUC framework might be able to enrich the individual areas of research, not just in the area of computer procrastination but elsewhere. This is discussed in the following section.

5. How the Framework Accounts for the Other Research Areas

The HUC framework will now be used to understand and contextualize the contribution made by existing research areas. For each area, the issues that seem significant to the research community are analysed in terms of which aspect and which functioning (from the HUC framework) makes them significant. We will demonstrate, using the HUCF, why each of the areas either hasn't addressed or can't address the everyday experience of computer procrastination. A heatmap diagram, like that shown in Figure 1, is generated for each research area, in which the shading in the heatmap reflects the degree of significance the aspect has in the research area. For brevity, the textual analysis that underlies the heatmap shading is omitted. While it would be unfair to expect any given area to cover all of aspects in all of the functions noted in Figure 1, this use of the HUCF will allow us to understand what each research area looks at, and then to understand what additional aspects that area would need to look at to better address procrastination.

5.1. Psychology

Each scientific area tends to find one or two aspects of most interest (Basden, 2011). In the case of psychology it is mainly the PSYCHIC/SENSITIVE aspect, concerned with mental functioning, which includes feeling, sensing, response, and emotion. Some cognitive psychology also focuses on our ANALYTIC functioning, opening up an interest in conceptualization, distinction-making and reasoning. However, in focusing on these, other aspects can be considered, with a different flavour. For example an AESTHETIC *feeling* of fun versus a JURIDICAL *feeling* of unfairness.

Personality traits may be seen as mental functioning that tends towards different aspects. Thus, the traits listed in Section 3.1 that have been related to procrastination each have a central correlating aspect (though each involves other aspects as well):

- conscientiousness – JURIDICAL
- self-esteem – PISTIC
- irrational beliefs – ANALYTIC
- self-handicapping – ECONOMIC
- impulsiveness – FORMATIVE
- anxiety / depression – PSYCHIC/SENSITIVE

The task characteristics listed in Section 3.1 also indicate our mental functioning related to other aspects: aversiveness, timing and boredom being meaningful in the PSYCHIC/SENSITIVE, ECONOMIC and AESTHETIC aspects respectively.

We can thus see a range of aspect which the field of the psychology would need to consider in order to address the everyday experience computer procrastination. However when we aspectually analyse a number of relevant texts in the field of procrastination psychology, we find that many of these aspects are overlooked. Figure 2 shows, in heatmap form, which aspects the field of psychology finds of most importance. Dark shades are used for the main areas of focus (PSYCHIC/SENSITIVE, ANALYTIC), with lighter shades for those aspects that lend flavour to these.

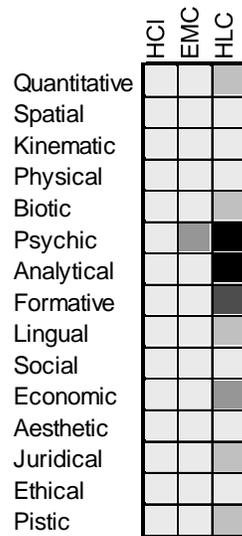


Figure 2: Heatmap display of aspects that the field of psychology finds important

Most of the aspects are in the HLC column because they are aspects of the individual functioning within life, rather than engaging with meaningful content (EMC) or the technology (HCI). There is one exception, that psychology can investigate the notion of “task aversiveness”, which moves towards EMC functioning in the PSYCHIC/SENSITIVE aspect.

This analysis of the main interests of psychology can explain both the potential and limitations of psychology in addressing computer procrastination. It explains why psychology can provide insight into the behaviour of delaying and to some extent into the irrationality, since these are aspects of HLC. However, it cannot adequately reason about why the procrastinatory application is so tempting and easy to switch to, because these are aspects of interaction with technology and information. These are most prominent in the HCI and EMC columns, which psychology is not able to address.

5.2. Human-Computer Interaction (HCI)

The field of human-computer interaction studies the engagement of humans with computer technology (the user interface) at the level of individual users rather than society, and also considers design of user interfaces (Carroll, 2010). This article concerns only use; design issues are for future research.

HCI, of course, is concerned mainly with human engagement with the interface, only secondarily with its meaning (EMC), and hardly at all with HLC. This accounts for the blanks in Table 2. It should therefore be able in principle to provide insights into the HCI element of computer procrastination.

Why it has so far not discussed this everyday problem may be explained by looking at the aspects of the interaction on which it focuses. Aspectually speaking, HCI concentrates on:

- PSYCHIC/SENSITIVE aspect – ergonomics, sensorimotor channels
- ANALYTIC aspect – interface objects
- FORMATIVE aspect – structure of dialogue
- LINGUAL aspect – affordances (that interface object structures convey meaning)
- SOCIAL aspect – collaborative work, social convention for interface use
- AESTHETIC aspect – visual appeal, harmonious ease-of-use

This may be visually expressed in the heatmap in Fig. 3, which also shows some secondary aspects.

Procrastination however is most centrally meaningful in:

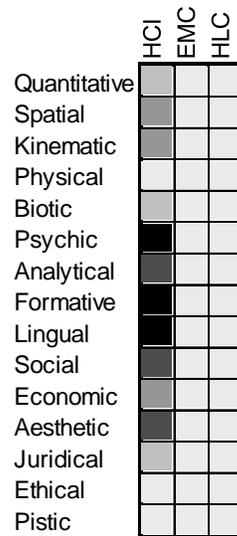


Figure 3: Heatmap display of aspects that the field of Human-Computer Interaction finds important

- SPATIAL, KINEMATIC aspect – proximity of procrastinatory application on screen
- PSYCHIC/SENSITIVE aspect – aversive feelings from original task
- ECONOMIC aspect – waste of time
- AESTHETIC aspect – boring vs. attractive
- JURIDICAL aspect – inappropriateness of time use; not giving tasks their due
- PISTIC aspect – commitment, self-deception

It is thus not surprising that the HCI research field is silent on the problem of computer procrastination. Even if HCI research were to be broadened to include HLC and EMC, the problem of procrastination is not meaningful or interesting in the aspects most frequently of interest to HCI researchers. 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.

5.3. Technology Acceptance Model (TAM)

The two central concepts of Davis' (1989) Technology Acceptance Model, perceived usefulness (PU) and perceived ease-of-use (PEOU), fit reasonably well

within the HUC framework, since PEOU is determined mainly by HCI, and PU by HLC. EMC is not recognised by TAM. Because the attractiveness of procrastinating arises out of EMC functioning, the HUC framework predicts that TAM will not be able to provide many insights into the irrational excuses made and the self-deception that the content being engaged with is useful, but it could in principle provide some insights into others.

Aspectual analysis of the concerns in TAM was performed by analysing the measurement instruments in constructs proposed by Davis (1989) and updated by Venkatesh (2003) is depicted in Figure 4; the detailed discussion of this analysis is not given here. This reveals that TAM's interest in HCI (mainly ease of use) focuses most heavily on the ANALYTICAL, FORMATIVE, LINGUAL, and ECONOMIC aspects. Its interest in HLC (mainly PU) is mainly in the FORMATIVE (enhancing performance in the work environment) and ECONOMIC (saving time and effort) aspects, and also the ANALYTICAL (perceiving whether the system helps with performance), and SOCIAL (appeal to social norms of other co-workers using it) aspects.

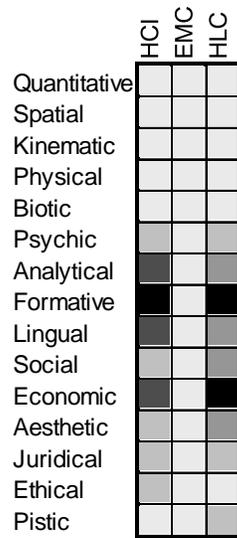


Figure 4: Heatmap display of aspects that the Technology Acceptance Model finds important

Probably because of its focus on work-related applications in organisations, rather than on everyday IS use, TAM finds only a narrow range of aspects important. TAM lacks a *whole computer, whole life* orientation that is important for understanding computer procrastination.

5.4. Non-work-related Internet Use (NWRIU)

Because NWRIU research originates in the field of management and organizational behaviour, it is no surprise to find the ECONOMIC aspect as most meaningful. An aspectual analysis of several important papers in NWRIU (Lim (2002), Garrett and Danziger (2008), Blanchard and Henle (2008), and Woon and Pee (2004)) is depicted in Figure 5. It reveals that the following aspects are important in human life with the Internet (HLC):

- SPATIAL: “cyberloafers need not be absent from the office for inexplicably long periods of time” (Lim, 2002, pg 678)
- FORMATIVE: External locus of control (Blau et al., 2006; Blanchard & Henle, 2008; Vitak et al., 2011). Computer experience (Garrett & Danziger, 2008; Vitak et al., 2011).
- SOCIAL: Gender, youth, and membership of minority groups (Vitak et al., 2011). Perceptions that co-workers’ and institutional norms allow it (Blanchard & Henle, 2008; Liberman et al., 2011).
- ECONOMIC: waste of time and the employer’s resources (most authors).
- AESTHETIC: Job satisfaction (Garrett & Danziger, 2008).
- JURIDICAL: Perceptions of unfair treatment (Blau et al., 2006; Lim, 2002). Misuse of employer resources (most authors).
- PISTIC: Optimism about computer use (Garrett & Danziger, 2008; Vitak et al., 2011). Mistrust between management and employees (Blanchard & Henle, 2008, pg 1080). Job commitment (Garrett & Danziger, 2008).

The area also recognises some aspects of EMC:

- ANALYTIC: Distinguish the type of content being engaged with (especially work vs. non-work).
- FORMATIVE: structure of a hypertext document invites distraction, starting from a legitimate web page, hyperlinks can quickly bring the employee to non-work-related content.
- LINGUAL: The kinds of content engaged with, such as email, chat or blogs.
- JURIDICAL: Whether that content is legitimately work-related or otherwise acceptable.

As may be seen from Figure 5, NWRIU ignores HCI but recognises a variety of aspects in both HLC and EMC as significant. This suggests that NWRIU might be able to provide useful insights into computer procrastination. Recognition

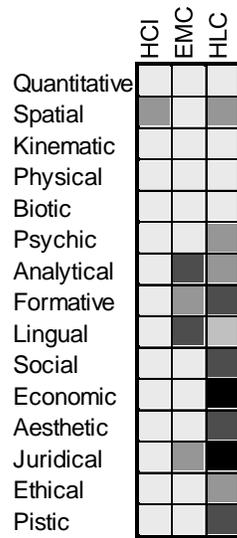


Figure 5: Heatmap display of aspects that the field of Non-Work-Related Internet Use finds important

of the multi-aspectual nature of NWRIU can be seen in, for example, Garrett and Danziger's (2008, pg 938) call for an approach which is "complementary and reinforcing of other explanations rather than in competition with them". However, many in the field narrow their interest down to a single aspect, as in Lim's (2002) exclusive focus on the JURIDICAL aspect in the lens of perceived organizational injustice, and such work is unlikely to advance our understanding of computer procrastination.

The SPATIAL and ECONOMIC aspects of HLC and the FORMATIVE aspect of EMC manifest themselves in similar ways in NWRIU and computer procrastination, so the field might provide useful insight there. However, in other aspects this is not so. For example, the PISTIC aspect of HLC refers to failure of trust in and commitment to the employer in NWRIU, but to self-deception in computer procrastination. The FORMATIVE aspect of HLC in computer procrastination refers to a failure of willpower, while NWRIU assumes that action directly follows from intention. Findings related to these aspects might mislead if applied to computer procrastination.

NWRIU is the first of the areas discussed here that recognises normativity. However, the criteria by which inappropriate use is differentiated from appropriate in NWRIU are rather narrow and ambiguous, such as Blanchard and Henle's (2008) appeal to social norms. Social norms can change and themselves require critique, and it is not clear that they can provide an adequate understanding of being "worse off" in computer procrastination. Dooyeweerd's

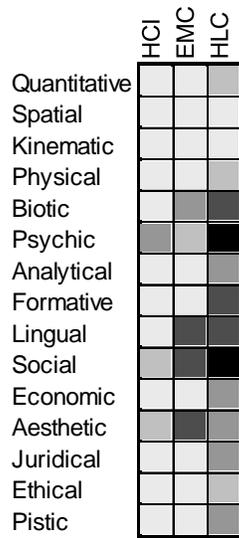


Figure 6: Heatmap display of aspects that the field of Problematic Internet Use finds meaningful

aspects also recognise normativity, providing not just a deeper foundation for addressing normativity but also more precision about kinds of normativity.

Thus Dooyeweerd's aspects might enrich NWRIU research as well as accounting for computer procrastination. Aspects that are overlooked in NWRIU, such as the LINGUAL and ETHICAL, can be suggested as worthy of research. Different manifestations of recognised aspects can be advocated. That NWRIU already recognises many aspects suggests that its current restriction of interest to work-related use could be relaxed; It is increasingly recognised that a strict demarcation between office and personal life is not tenable in today's environment. The HUC framework might provide a solidly-founded way of relaxing this while retaining a principled basis on which legitimate concerns of both employers and employees might be discussed.

5.5. Problematic Internet Use (PIU)

To form the heatmap of what is important in the field of Problematic Internet Use, depicted in Figure 6, several seminal papers (Caplan et al., 2009; Young et al., 2011; Young, 2011) and two diagnostic tests for PIU, the Internet Addiction Test (Widyanto & McMurrin, 2004) and the Internet Addiction Diagnostic Questionnaire (Young, 1998) were examined.

Like NWRIU, PIU's emphasis is in HLC functioning; however, it recognises everyday life and not just the use in the workplace. The following aspects are particularly important in HLC:

- BIOTIC: reduced health (Kwon, 2011; Young, 2011).
- PSYCHIC/SENSITIVE: avoidance of unpleasant feelings and emotions in other areas of life (Young et al., 2011; Widyanto & McMurrin, 2004, pg 13)
- SOCIAL: impoverished real-life relationships (Young et al., 2011, pg 12) (as antecedent or consequence) and increased online relationships.
- FORMATIVE: the user no longer has the ability to shape or control the role the internet plays in their life (Young, 1998).

A few aspects of EMC and HCI are also recognised by Caplan and High (2011) and LaRose (2011), in terms of which kinds of content are most often problematic:

- LINGUAL EMC: Chat and email
- SOCIAL EMC: social networking
- AESTHETIC: game playing
- SOCIAL HCI: anonymity and lack of face-to-face communication

PIU is the only area that recognises something of each of HCI, EMC and HLC, and thus might show most promise in understanding computer procrastination. However, its recognition of HCI and EMC is rather weak compared with what is needed to understand computer procrastination, and the aspects it finds meaningful in HLC do not coincide exactly with those meaningful for procrastination. The distinction between PIU and procrastination can best be seen in the observation that PIU is a pathological situation, while procrastination can seemingly occur in otherwise healthy, functioning adults. The framework can provide insight about this by appealing to the BIOTIC aspect and its norms of health and flourishing. Intuitively, PIU seems to result in a sickness that requires clinical treatment, while procrastination, whatever its dysfunction, does not.

5.6. Computer and Internet Procrastination

For comparison purposes, Figure 7 collects the heatmaps for each area and shows them alongside that for computer procrastination. It summarises the above discussion that explains why each area is unable to address computer procrastination without significant re-orientation. However, the orientation required of each is different.

Several things become clear. First, no single current field finds meaningful all the diverse factors that are important in computer procrastination. Second,

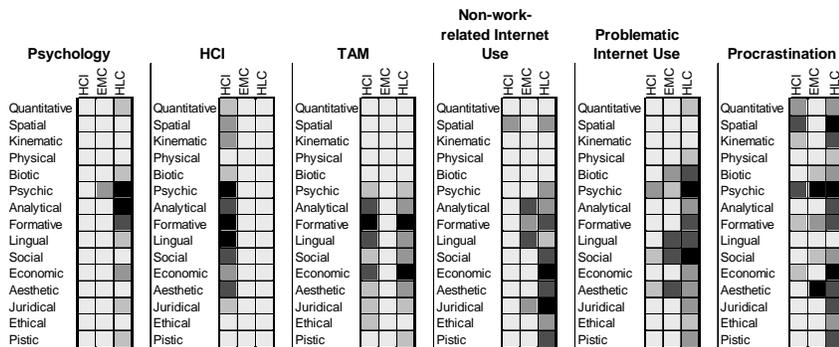


Figure 7: The “big picture” of other research areas relevant to computer procrastination

nevertheless, each of the areas of research can be expected to offer important insights into computer procrastination in several ways. Third, even so, a union of all five fields is unlikely to cover all of the meaningful aspects, because though a wide range of aspects in each functioning would be covered, it would be difficult to integrate them. Fourth, the HUC framework is capable of accounting for and incorporating each of the research areas, and to meaningfully discuss the entirety of the problem.

6. Conclusion

Computer procrastination wastes much time in today’s digital lifestyles, yet it has not been adequately researched. This paper has posed two questions:

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

The first question was addressed by identifying several main characteristics of computer procrastination (Section 2) and showing how each of five other research areas do not adequately cover these (Section 3). However, the characteristics themselves are not yet universally agreed upon because so little research has occurred, so a firmer basis for answering question 1 needed to be found. This involves answering question 2, though its main purpose is to give direction to the much-needed research.

A good basis for understanding computer procrastination may be found in Basden’s (2008) Human Use of Computers framework, which sees it as the user’s engagement with three things simultaneously: with the technical interface in Human-Computer Interaction (HCI), with meaningful content (EMC), and with life as such in Human Living with Computers (HLC). Each engagement itself exhibits many different aspects, so the HUC framework employs the suite of fifteen aspects developed by the philosopher Herman Dooyeweerd(1955).

These are intended not just as an ontological taxonomy, but to express the richness, diversity and coherence of everyday experience in any field.

This framework was explained in Section 4 and its utility for understanding the complexity of computer procrastination was demonstrated with an example case. Viewing the five areas of research through the lens of the HUC framework, revealed the limitations of each.

Our proposal is that, in order to study computer procrastination adequately, and perhaps to design against it, all aspects of all three engagements need to be taken into account. While the effects of computer procrastination take place primarily within HLC functioning, HCI functioning can help us see that ease of switching between applications is a significant contributor to the problem, and EMC supplies insight into the attractiveness of the procrastinatory activity. The HUC framework makes the inherent complexity manageable without trying to hide it, and is thus offered as a theoretical basis for, and stimulant of, research in computer procrastination.

6.1. Limitations

There are obvious limitations to both this proposal and to the argument for it, and each indicates potential for further research into addressing the two questions.

First, the use of Basden's (2008) idea of three engagements can be criticised as overlooking IS design and development and the impact on and of society. However, both of these topics are covered in different parts of Basden (2008) in a way that integrates with the HUC framework. The sufficiency of Dooyeweerd's aspects can also be questioned, but Dooyeweerd's aspects have advantages over alternative sets of aspects, ranging from Maslow's (1943) hierarchy of needs to Hartmann's (1952) "new ontology", by being more comprehensive, having a sounder philosophical basis, and being oriented to everyday life rather than theoretical or professional rationalization (Basden, 2008).

Second, the generality of the single case study may be questioned. However, the analysis focused on those factors which are common to other experiences of computer procrastination. The purpose of the case study was merely to illustrate potential of the HUC framework, rather than prove its adequacy. It also reveals how wide a range of issues could be meaningful to computer procrastination. The adequacy or otherwise of the framework will only be established once a range of research into computer procrastination is under way. It is such research that the framework is intended to stimulate and make possible.

Third, the selection of five other research areas may be criticised as too narrow. For example, literature on resistance and power, and on information fulfilment, were not included, and could be for a fuller study. These could be included in both Sections 3 and 5. However, we believe that examining these five are sufficient to justify the proposal that the HUC framework will be useful in addressing computer procrastination.

Finally, three sections of this paper depend on the authors' interpretation: of characteristics of computer procrastination, of what each area of research covers, and of the case study. There is room for disagreement about all. However, some element of interpretation cannot be escaped, and conceptual boundaries are porous, so discussion of which issues are important will never end. The method of selection was explained, and others can repeat the exercise with different methods.

6.2. *Potential Contributions*

Despite the above limitations, this work offers several contributions. The first and most obvious one is that it provides a clear and systematic framework for understanding and discussing what is meaningful in computer procrastination. To differentiate clearly between kinds of engagement and between different aspects thereof can facilitate research design. Though the framework recognises that in most cases computer procrastination will be detrimental, it has the flexibility to recognise that in some cases it might be beneficial, or even a mix of both, because it can separate out distinct ways of being beneficial and detrimental.

Related to this, the framework could be useful when designing to minimise computer procrastination. Designers should not consider only the HCI, but also the meaningful content and the life and activities of the user. They should consider not only the obvious aspects like the ANALYTICAL and AESTHETIC, but also others. The importance of the PISTIC and ETHICAL aspects (beliefs and attitudes), for example, is often overlooked.

Third, it can clarify what kind of contribution might potentially (or actually) be made by the research areas. For example, the field of psychology can contribute findings about various aspects of HLC, while that of HCI can contribute findings about HCI. However, this discussion has also clearly revealed the fundamental limitations of each field as currently constituted, which can avert the confusion that comes from research methods and theories being applied in inappropriate ways.

Fourth, this approach might also suggest how each field might be enriched in its own right. Every field was seen to focus on certain aspects; it might be useful for each to actively consider aspects that it has so far overlooked. For example, the psychology of computer use might benefit from recognising the PISTIC, ETHICAL and JURIDICAL aspects, rather than assuming they can be reduced to feelings. Dooyeweerd, while emphasising the mutual irreducibility between such aspects, also provides conceptual tools for exploring the interdependency between them.

Fifth, very few fields recognise all three human engagements. Though it would be inappropriate to suggest that all fields focus on all engagements equally, since the focus of each field gives it its unique character, nevertheless each field could develop structural ways to recognise the meaningfulness of others,

and thus find a way to benefit from each other. For example, the psychology of computer use might do well to explore the differences between engaging with information and engaging with life in general.

Computer procrastination is likely to be of increasing importance over the next few years, with the universal spread of tablets and mobile devices. Collectively, the amount of time diverted from more productive activity might be huge. Perhaps humanity will achieve more - in every aspect including the AESTHETIC aspect of fun - if this hidden yet growing phenomenon is properly understood. By adopting the framework outlined in this paper, the authors hope that others will be able to research computer procrastination more systematically and more fully, and build up the common body of understanding that is required.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179 – 211. doi:10.1016/0749-5978(91)90020-T.

Andreou, C. (2007). Understanding procrastination. *Journal for the Theory of Social Behaviour*, 37, 183 – 193.

Bailey, B. P., & Konstan, J. A. (2006). On the need for attention-aware systems: Measuring effects of interruption on task performance, error rate, and affective state. *Computers in Human Behavior*, 22, 685 – 708. doi:DOI: 10.1016/j.chb.2005.12.009.

Basden, A. (2008). *Philosophical Frameworks for Understanding Information Systems*. Hershey, PA: IGI Publishing.

Basden, A. (2011). Enabling a kleinian integration of interpretivist and socio-critical is research: the contribution of dooyeweerd's philosophy. *EJIS*, 20, 477–489.

Beard, K. W. (2011). Working with adolescents addicted to the internet. In K. S. Young, & C. N. de Abrue (Eds.), *Internet Addiction: A Handbook and Guide to Evaluation and Treatment* chapter 10. (pp. 173–189). John Wiley & Sons.

Bessière, K., Newhagen, J. E., Robinson, J. P., & Shneiderman, B. (2006). A model for computer frustration: the role of instrumental and dispositional factors on incident, session, and post-session frustration and mood. *Computers in Human Behavior*, 22, 941 – 961. URL: <http://www.sciencedirect.com/science/article/pii/S0747563204000615>. doi:<http://dx.doi.org/10.1016/j.chb.2004.03.015>.

Blanchard, A. L., & Henle, C. A. (2008). Correlates of different forms of cyberloafing: The role of norms and external locus of control. *Computers in Human Behavior*, 24, 1067 – 1084. doi:10.1016/j.chb.2007.03.008.

Blatt, S. J., & Quinlan, P. (1967). Punctual and procrastinating students: A study of temporal parameters. *Journal of Consulting Psychology*, 31, 169–174.

- Blau, G., Yang, Y., & Ward-Cook, K. (2006). Testing a measure of cyberloafing. *Journal of Allied Health, 35*, 9–17.
- Blunt, A. K., & Pychyl, T. A. (2000). Task aversiveness and procrastination: a multi-dimensional approach to task aversiveness across stages of personal projects. *Personality and Individual Differences, 28*, 153 – 167. doi:10.1016/S0191-8869(99)00091-4.
- Brownlow, S., & Reasinger, R. D. (2000). Putting off until tomorrow what is better done today: Academic procrastination as a function of motivation toward college work. *Journal of Social Behavior & Personality, 15*, 15 – 34.
- Caplan, S., Williams, D., & Yee, N. (2009). Problematic internet use and psychosocial well-being among MMO players. *Comput. Hum. Behav., 25*, 1312–1319. doi:http://dx.doi.org/10.1016/j.chb.2009.06.006.
- Caplan, S. E., & High, A. C. (2011). Online social interaction, psychosocial well-being, and problematic internet use. In K. S. Young, & C. N. de Abreu (Eds.), *Internet Addiction: A Handbook and Guide to Evaluation and Treatment*. John Wiley & Sons.
- Carroll, J. M. (2010). Conceptualizing a possible discipline of human-computer interaction. *Interacting with Computers, 22*, 3 – 12. doi:10.1016/j.intcom.2009.11.008.
- Carroll, J. M. (2013). Human computer interaction - brief intro. In M. Soegaard, & R. F. Dam (Eds.), *The Encyclopedia of Human-Computer Interaction, 2nd Ed.*. Aarhus, Denmark: The Interaction Design Foundation. URL: http://www.interaction-design.org/encyclopedia/human_computer_interaction_hci.html.
- Davis, D., & Abbitt, J. (2013). Using sms texting to reduce procrastination in large-enrollment courses: An exploratory study. In R. McBride, & M. Searson (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2013* (pp. 3119–3121). New Orleans, Louisiana, United States: AACE. URL: <http://www.editlib.org/p/48574>.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, (pp. 319–339).
- Davis, R. A., Flett, G. L., & Besser, A. (2002). Validation of a new scale for measuring problematic internet use: Implications for pre-employment screening. *CyberPsychology & Behavior, 5*, 331 – 345.
- de Abreu, C. N., & Góes, D. S. (2011). Psychotherapy for internet addiction. In K. S. Young, & C. N. de Abreu (Eds.), *Internet Addiction: A Handbook and Guide to Evaluation and Treatment* chapter 9. (pp. 155–171). John Wiley & Sons.
- Dix, A., Finlay, J., Abowd, G. D., & Beale, R. (2004). *Human-Computer Interaction*. (3rd ed.). Upper Saddle River, NJ, USA: Pearson Prentice Hall.

- Dooyeweerd, H. (1955). *A New Critique of Theoretical Thought* volume 1-4. Philadelphia, USA: Presbyterian and Reformed. Translated by David Freeman and William Young.
- Fee, R. L., & Tangney, J. P. (2000). Procrastination: A means of avoiding shame or guilt?. *Journal of Social Behavior & Personality*, *15*, 167 – 184.
- Ferrari, J. R. (1992). Psychometric validation of two procrastination inventories for adults: Arousal and avoidance measures. *Journal of Psychopathology and Behavioral Assessment*, *14*, 97–110.
- Ferrari, J. R., & Tice, D. M. (2000). Procrastination as a self-handicap for men and women: A task-avoidance strategy in a laboratory setting. *Journal of Research in Personality*, *34*, 73 – 83. doi:10.1006/jrpe.1999.2261.
- Fishbein, M., & Ajzen, I. (1975). *Belief, Attitude, Intention and Behaviour: An Introduction to Theory and Research*. Addison-Wesley.
- Frangos, C. C., Frangos, C. C., & Sotiropoulos, I. (2011). Problematic internet use among greek university students: An ordinal logistic regression with risk factors of negative psychological beliefs, pornographic sites, and online games. *Cyberpsychology, Behavior, and Social Networking*, *14*, 51 – 58.
- Garrett, R. K., & Danziger, J. N. (2008). Disaffection or expected outcomes: Understanding personal internet use during work. *Journal of Computer-Mediated Communication*, *13*, 937–958. doi:10.1111/j.1083-6101.2008.00425.x.
- Geranios, N. K. (2009). Internet addiction center opens in US. Associated Press, access online, <http://www.newsday.com/business/technology/internet-addiction-center-opens-in-us-1.1419946>.
- Gjelsvik, O. (2010). Prudence, procrastination, and rationality. In C. Andreou, & M. D. White (Eds.), *The Thief of time; Philosophical essays on procrastination* chapter 6. (pp. 99–114). Oxford University Press.
- Greenfield, D. (2011). The addictive properties of internet usage. In K. S. Young, & C. N. de Abreu (Eds.), *Internet Addiction: A Handbook and Guide to Evaluation and Treatment* chapter 8. (pp. 135–153). John Wiley & Sons.
- Greeno, J. G. (1994). Gibson's affordances. *Psychological Review*, (pp. 336–342).
- Hartmann, N. (1952). *The new ways of ontology*. Chicago: Chicago University Press.
- Hirschheim, R. (2007). Introduction to the special issue on "quo vadis tam – issues and reflections on technology acceptance research". *Journal of the Association for Information Systems*, *8*, 204 – 205.
- Hudlicka, E. (2003). To feel or not to feel: The role of affect in human-computer interaction. *International Journal of Human-Computer Studies*, *59*, 1 – 32. doi:10.1016/S1071-5819(03)00047-8.

- Johnson, C. (2011). Slow your bandwidth to increase your focus. <http://www.informationdiet.com/blog/read/slow-your-bandwidth-to-increase-your-focus>. Accessed August 5, 2013.
- Johnson, J. L., & Bloom, A. (1995). An analysis of the contribution of the five factors of personality to variance in academic procrastination. *Personality and Individual Differences, 18*, 127 – 133. doi:10.1016/0191-8869(94)00109-6.
- Kachgal, M. M., Hansen, L. S., & Nutter, K. J. (2001). Academic procrastination prevention/intervention: Strategies and recommendations. *Journal of Developmental Education, 25*, 14.
- Kalwar, S. K., Heikkinen, K., & Porras, J. (2012). Conceptual framework for assessing human anxiety on the internet. *Procedia - Social and Behavioral Sciences, 46*, 4907 – 4917.
- Klosowski, T. (2012). Is the internet really making me stupid, crazy, and constantly distracted? <http://lifehacker.com/5927763/>. Accessed August 5, 2013.
- Kwon, J.-H. (2011). Toward the prevention of adolescent internet addiction. In K. S. Young, & C. N. de Abreu (Eds.), *Internet Addiction: A Handbook and Guide to Evaluation and Treatment* chapter 13. (pp. 223–243). John Wiley & Sons.
- LaRose, R. (2011). Uses and gratifications of internet addiction. In K. S. Young, & C. N. de Abreu (Eds.), *Internet Addiction: A Handbook and Guide to Evaluation and Treatment*. John Wiley & Sons.
- Lavoie, J. A. A., & Pychyl, T. A. (2001). Cyberslacking and the procrastination superhighway: A web-based survey of online procrastination, attitudes, and emotion. *Social Science Computer Review, 19*, 431 – 444. doi:10.1177/089443930101900403.
- Lay, C. H. (1986). At last, my research article on procrastination. *Journal of Research in Personality, 20*, 474 – 495. doi:10.1016/0092-6566(86)90127-3.
- Lee, Y., Kozar, K. A., & Larsen, K. R. T. (2003). The technology acceptance model: Past, present, and future. *Communications of AIS, 12*, 752 – 780.
- Lieberman, B., Seidman, G., McKenna, K. Y., & Buffardi, L. E. (2011). Employee job attitudes and organizational characteristics as predictors of cyberloafing. *Computers in Human Behavior, 27*, 2192 – 2199. doi:10.1016/j.chb.2011.06.015.
- Lim, V. K. G. (2002). The IT way of loafing on the job: Cyberloafing, neutralizing and organizational justice. *Journal of Organizational Behavior, 23*, 675–694. doi:10.1002/job.161.
- Maslow, A. H. (1943). A theory of human motivation. *Psychological Review, 50*, 370–396. doi:doi:10.1037/h0054346.

- Milgram, N., Mey-Tal, G., & Levison, Y. (1998). Procrastination, generalized or specific, in college students and their parents. *Personality and Individual Differences, 25*, 297 – 316. doi:10.1016/S0191-8869(98)00044-0.
- Mitcham, C. (1994). *Thinking through Technology: the Path between Engineering and Philosophy*. University of Chicago Press.
- Mnookin, S. (2007). Thanks to google's tools, i'm the most efficient time-waster ever. http://www.wired.com/culture/lifestyle/news/2007/10/st_trouble. Accessed august 5, 2013.
- Norman, D. A. (1999). Affordance, conventions, and design. *interactions, 6*, 38–43. doi:http://doi.acm.org/10.1145/301153.301168.
- O'Donoghue, T., & Rabin, M. (1999). Doing it now or later. *American Economic Review, 89*, 103 – 124.
- OED Online (2012). "procrastination, n.". URL: <http://www.oed.com/view/Entry/151862>.
- Peterson, K. E. (1987). *Relationships among measures of writer's block, writing anxiety, and procrastination*. Ph.D. thesis Ohio State University Columbus, Ohio, USA.
- Pychyl, T. A., Lee, J. M., Thibodeau, R., & Blunt, A. (2000). Five days of emotion: An experience sampling study of undergraduate student procrastination. *Journal of Social Behavior & Personality, 15*, 239 – 254.
- Rothblum, E. D., Solomon, L. J., & Murakami, J. (1986). Affective, cognitive, and behavioral differences between high and low procrastinators. *Journal of Counseling Psychology, 33*, 387–394.
- Schouwenburg, H. C., & Groenewoud, J. (2001). Study motivation under social temptation; effects of trait procrastination. *Personality and Individual Differences, 30*, 229 – 240. doi:10.1016/S0191-8869(00)00034-9.
- Schouwenburg, H. C., & Lay, C. H. (1995). Trait procrastination and the big-five factors of personality. *Personality and Individual Differences, 18*, 481 – 490. doi:10.1016/0191-8869(94)00176-S.
- Shi, J., Chen, Z., & Tian, M. (2011). Internet self-efficacy, the need for cognition, and sensation seeking as predictors of problematic use of the internet. *Cyberpsychology, Behavior, and Social Networking, 14*, 231 – 234.
- Silver, M., & Sabini, J. (1981). Procrastinating. *Journal for the Theory of Social Behaviour, 11*, 207–221. doi:10.1111/j.1468-5914.1981.tb00033.x.
- Soloman, L. J., & Rothblum, E. D. (1984). Academic procrastination: Frequency and cognitive-behavioral correlates. *Journal of Counseling Psychology, 31*, 503–509.

- Steel, P. (2007). The nature of procrastination: A meta-analytic and theoretical review of quintessential self-regulatory failure. *Psychol. Bull.*, *133*, 65–94. doi:10.1037/0033-2909.133.1.65.
- Strauss, D. (2009). *Philosophy: Discipline of the Disciplines*. Jordan Station, Ontario, Canada: Paideia Press.
- Strongman, K. T., & Burt, C. D. B. (2000). Taking breaks from work: An exploratory inquiry. *Journal of Psychology*, *134*, 229.
- Talbott, S. L. (1995). *The Future Does Not Compute: Transcending the Machines in our Midst*. O'Reilly & Associates.
- Teo, T. S., Lim, V. K., & Lai, R. Y. (1999). Intrinsic and extrinsic motivation in internet usage. *Omega*, *27*, 25 – 37. URL: <http://www.sciencedirect.com/science/article/pii/S0305048398000280>. doi:10.1016/S0305-0483(98)00028-0.
- Thatcher, A., Wretchko, G., & Fisher, J. (2008). Problematic internet use among information technology workers in South Africa. *CyberPsychology & Behavior*, *11*, 785–787. doi:10.1089/cpb.2007.0223.
- Tice, D. M., & Baumeister, R. F. (1997). Longitudinal study of procrastination, performance, stress, and health: The costs and benefits of dawdling. *Psychological Science*, *8*, 454 – 458.
- van Eerde, W. (2003). A meta-analytically derived nomological network of procrastination. *Personality and Individual Differences*, *35*, 1401 – 1418. doi:10.1016/S0191-8869(02)00358-6.
- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*, 425 – 478.
- Vitak, J., Crouse, J., & LaRose, R. (2011). Personal internet use at work: Understanding cyberslacking. *Computers in Human Behavior*, *27*, 1751 – 1759. doi:10.1016/j.chb.2011.03.002.
- Vodanovich, S. J., & Rupp, D. E. (1999). Are procrastinators prone to boredom?. *Social Behavior & Personality: An International Journal*, *27*, 11–16.
- Widyanto, L., & McMurrin, M. (2004). The psychometric properties of the internet addiction test. *CyberPsychology & Behavior*, *7*, 443 – 450.
- Woon, I. M., & Pee, L. G. (2004). Behavioral factors affecting internet abuse in the workplace - an empirical investigation. In *Proceedings of the Third Annual Workshop on HCI Research in MIS* (pp. 80–84).

- Yellowlees, P. M., & Marks, S. (2007). Problematic internet use or internet addiction? *Computers in Human Behavior*, 23, 1447 – 1453. doi:DOI: 10.1016/j.chb.2005.05.004. Including the Special Issue: Avoiding Simplicity, Confronting Complexity: Advances in Designing Powerful Electronic Learning Environments.
- Young, K. S. (1998). *Caught in the Net: How to Recognize the Signs of Internet Addiction – and a Winning Strategy for Recovery*. John Wiley & Sons.
- Young, K. S. (2011). Clinical assessment of internet-addicted clients. In K. S. Young, & C. N. de Abreu (Eds.), *Internet Addiction: A Handbook and Guide to Evaluation and Treatment*. John Wiley & Sons.
- Young, K. S., & de Abreu, C. N. (Eds.) (2011). *Internet Addiction: a Handbook and Guide to Evaluation and Treatment*. John Wiley & Sons.
- Young, K. S., Yue, X. D., & Ying, L. (2011). Prevalence estimates and etiologic models of internet addiction. In K. S. Young, & C. N. de Abrue (Eds.), *Internet Addiction: A Handbook and Guide to Evaluation and Treatment* chapter 1. (pp. 3–18). John Wiley & Sons.
- Zeng, Z., Pantic, M., Roisman, G., & Huang, T. (2009). A survey of affect recognition methods: Audio, visual, and spontaneous expressions. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 31, 39–58.