Tinnitus in Context

A Contemporary Contextual Behavioral Approach
Hugo Hesser

Linköping University
Linköping Studies in Arts and Science No. 570
Studies from the Swedish Institute for Disability Research No. 45
Linköping University
Department of Behavioural Sciences and Learning
Linköping 2013
At the Faculty of Arts and Science at Linköping University, research and doctoral studies are carried out within broad problem areas. Research is organized in interdisciplinary research environments and doctoral studies mainly in graduate schools. Jointly, they publish the series Linköping Studies in Arts and Science. This thesis comes from the Swedish Institute for Disability Research at the Department of Behavioural Sciences and Learning.

Distributed by:
Department of Behavioural Sciences and Learning
Linköping University
581 83 Linköping

Hugo Hesser
Tinnitus in Context:
A Contemporary Contextual Behavioral Approach

Edition 1:1
ISSN 0282-9800
ISSN 1650-1128

©Hugo Hesser
Department of Behavioural Sciences and Learning, 2013

Printed by: LiU-tryck, Linköping 2013

All previously published articles were reproduced with permission from the publisher.
Till minne av pappa
ABSTRACT

Tinnitus is the experience of sounds in the ear without any external auditory source and is a common, debilitating, chronic symptom for which we have yet to develop sufficiently efficacious interventions. Cognitive behavioral therapy (CBT) has evolved over the last 20 years to become the most empirically supported treatment for treating the adverse effects of tinnitus. Nevertheless, a significant proportion of individuals do not benefit from CBT-based treatments. In addition, the theoretical underpinnings of the CBT-model are poorly developed, the relative efficacy of isolated procedures has not yet been demonstrated, and the mechanisms of therapeutic change are largely unknown. These significant limitations preclude scientific progression and, as a consequence, leave many individuals with tinnitus suffering.

To address some of these issues, a contextual multi-method, principle-focused inductive scientific strategy, based on pragmatic philosophy, was employed in the present thesis project. The overarching aim of the thesis was to explore the utility of a functional dimensional process in tinnitus: Experiential avoidance—experiential openness/acceptance (EA). EA is defined as the inclination to avoid or alter the frequency, duration, or intensity of unwanted internal sensations, including thoughts, feelings or physical sensations. The thesis is based on experimental work (Study II, VI), process and mediation studies (Study I, III, V), and on randomized controlled trials (Study III, IV).

Three main sets of findings supported the utility of EA in tinnitus. First, an acceptance-based treatment (i.e., Acceptance and Commitment Therapy, ACT) was found to be effective in controlled trials. Study III demonstrated that face-to-face ACT was more effective than a wait-list control and a habituation-based sound therapy. Study IV showed that internet-delivered ACT was more effective than an active control condition (internet-discussion forum) and equally effective as an established internet-delivered CBT treatment. Second, processes research (Study I, III, V) showed that key postulated processes of change were linked to the specific technology of ACT and that these changes in processes were associated with therapeutic outcomes. Specifically, Study V found evidence to that decreases in suppression of thoughts and feelings over the course of treatment were uniquely associated with therapeutic gains in ACT as compared with CBT. Third, experimental manipulations of experiential avoidance and acceptance processes provided support to the underlying dimension (Study II, VI). That is, Study II, employing an experimental manipulation, found that controlling background sounds were associated with reduced cognitive efficiency and increased tinnitus interference over repeated experimental trials. In addition, in normal hearing
participants, experimentally induced mindfulness counteracted reduced persistence in a mentally challenging task in the presence of a tinnitus-like sound stemming from initial effortful suppression of the same sound (Study VI). It is concluded that a principle-, contextual-focused approach to treatment development may represent an efficient strategy for scientific progression in the field of psychological treatments of tinnitus severity.

Keywords: tinnitus, tinnitus distress, cognitive behavioral therapy, experiential avoidance, acceptance and commitment therapy
THE THESIS IS BASED ON THE FOLLOWING ORIGINAL RESEARCH PAPERS.


## CONTENTS

1. BACKGROUND
   Introduction 1
   Tinnitus: The Phenomenon 2
      Definition and Terminology 2
      Prevalence 4
      Etiology and Mechanism of Pathophysiology 6
   Tinnitus: The Problem 8
      Emotional and Psychiatric Problems 9
      Cognitive Functioning 10
      Sleep Disturbances 12
      Impact on Society 13
   Treatments 14
      Available Treatments 14
      Antidepressant Treatments 15
      Sound Enrichment/Masking Treatments 16
   Cognitive Behavior Therapy for Tinnitus 18
      Origin of CBT and Theoretical Underpinnings 19
      Effectiveness 20
      A New Delivery-Format: Self-help delivered via the Internet 23
      CBT for Tinnitus: Concluding Remarks 24
   Outlining a Research Program for the Development of CBT 25
      Acceptance and Mindfulness: An Emerging Trend in CBT 25
      Acceptance and Commitment Therapy 26
      ACT for Chronic Pain 28
      Experiential Avoidance as a Key Dimension in Psychopathology 29
      Acceptance as a Way to Counteract the Effects of Experiential Avoidance 31
      Can Severe Tinnitus be conceptualized as an Experiential Avoidance Disorder? 33
      How may Acceptance Counteract Experiential Avoidance in Tinnitus? 37
      Empirical Support to Acceptance in Tinnitus 40
   Scientific Strategy and Philosophy of Science 41
      Philosophical Assumptions 42
      Overall strategy: Examining Processes and Principles tied to Theory 43
      Methodology: A Multi-Method Approach 45

2. EMPIRICAL STUDIES
   Overarching Aim 49
Study I. Clients’ In-Session Acceptance and Cognitive Defusion Behaviors in Acceptance-based Treatment of Tinnitus Distress

Aim
Methods
Results and Discussion

Study II. Consequences of Controlling Background Sounds: The Effect of Experiential Avoidance on Tinnitus Interference

Aim
Methods
Results and Discussion

Study III. Acceptance and Commitment Therapy versus Tinnitus Retraining Therapy in the Treatment of Tinnitus:
A Randomised Controlled Trial

Aim
Methods
Results and Discussion

Study IV. A Randomized Controlled Trial of Internet-Delivered Cognitive Behavior Therapy and Acceptance and Commitment Therapy in the Treatment of Tinnitus

Aim
Methods
Results and Discussion

Study V. Acceptance as a Mediator in Internet-Delivered Acceptance and Commitment Therapy and Cognitive Behavior Therapy

Aim
Methods
Results and Discussion

Study VI. Costs of Suppressing Emotional Sound and Countereffects of a Mindfulness Induction: An Experimental Analog of Tinnitus Impact

Aim
Methods
Results and Discussion

3. GENERAL DISCUSSION
Establishing a Mechanism of Change:
Methodological Considerations and Challenges
Strong Associations
Specificity
PREFACE

In 1953, Heller and Bergman allowed 80 normal hearing participants to enter a soundproof room. After 5 minutes almost all participants (94%) reported hearing sounds that are commonly experienced by those who report tinnitus. These intriguing findings, which have partly been replicated, provided evidence for that tinnitus is contextually situated.

The current thesis project explores the utility of a contextual approach to treatment development. Contextual variables are the only variables we can influence directly and are, thus, from a pragmatic standpoint, of key importance within a scientific strategy that aims not only to understand a given phenomenon but also to influence it.

I must confess, that when I started this thesis project some years ago, I was not that interested in tinnitus. As a psychologist by training, I could not fully grasp my role and how I could help individuals with an irreversible medical symptom. However, over the years, through my work as a researcher and clinician within audiology, not only have I come to appreciate the integral role psychology plays in tinnitus distress and perception, but I have also become fascinated with the enigma that is tinnitus. I hope my thesis will do the complexity of the phenomenon justice, and that I can inspire more research efforts on the interplay between psychology and audiology. Finally, and most important, I hope the findings will be useful for those who are suffering from tinnitus.

Hugo Hesser
October 7, 2012
Never does the human soul appear so strong as when it foregoes revenge and dares to forgive an injury.

-Confucius
1. BACKGROUND

Introduction

Many, if not most, people have experienced noises in the ears in association with a temporary hearing loss after having been exposed to loud sounds. These auditory sensations are commonly described as whistling sounds and generally resolve within a few minutes after onset. Yet, for a significant proportion of individuals—approximately 10 to 15 percent in the adult population (Davis & El Refaie, 2000)—these auditory sensations persist over time in the absence of an external auditory source. This prolonged spontaneous auditory perceptual phenomenon is commonly referred to as tinnitus.

There are historical accounts of tinnitus dating back to ancient times, and the auditory phenomenon has continued to intrigue scientists and clinicians for centuries (Stephens, 2000). Although an abundance of scientific literature on tinnitus has been published during the last 20 years, truly effective treatments have yet to be discovered (Lockwood, Salvi, & Burkard, 2002). The unsuccessful scientific endeavor of finding a cure for tinnitus is most likely due to that the pathophysiology of tinnitus remains at the stage of hypothesis and theoretical speculations (Baguley, 2002). In fact, in the vast majority of cases the mechanisms of tinnitus generation are largely unknown. This is an unfortunate fact for millions of individuals worldwide who are troubled by tinnitus. A large number of people report considerable distress due to tinnitus in the form of problems with concentration, sleep, and negative affect (Tyler & Baker, 1983).

Psychological approaches to treatment of tinnitus aim to reduce impact and distress associated with the symptom. Among psychological treatments, behavioral therapies, cognitive therapies, or their integration (henceforth referred to as CBT or its full name) are the most extensively studied and have gained considerable empirical support over the years (Andersson, 2002). Still, although the empirical evidence provides support to CBT—CBT is to date the best empirically validated treatment for tinnitus interference and distress regardless of treatment modality (Martinez-Devesa, Perera, Theodoulou, & Waddell, 2010)—a substantial number of people continue the experience significant residual distress after treatment. Moreover, the theoretical underpinnings of the CBT-model are poorly developed, the relative efficacy of isolated procedures has not yet been demonstrated, and the mechanisms of
therapeutic change are largely unknown. Collectively, this makes it difficult to improve existent treatments, and, thus, rendering a substantial number of people with tinnitus suffering from the symptom without receiving adequate professional help.

To address some of the above-mentioned limitations of the extent scientific literature, a contextual scientific strategy, named contextual behavior science (Vilardaga, Hayes, Levin, & Muto, 2009), was employed in the current thesis project. This scientific strategy aim to develop a theoretical model of tinnitus severity based on clear philosophical assumptions; develop processes and principles in relation to theory; and to examine strategies and components linked to these processes and principles. In addition to the development of a new treatment model within the CBT-tradition, and the examination of the overall treatment effect of this new CBT-based treatment, an emphasis is also put on mediation and moderation in the analysis of impact, and on randomized experiments of isolated theory-driven techniques and principles. Specifically, the overriding aim of the current thesis project was to explore the utility of a functional dimensional process in tinnitus: Experiential avoidance—experiential openness/acceptance.

Tinnitus: The Phenomenon

Definition and Terminology

Tinnitus derives from the Latin *tinnire* meaning “to ring”. Thus, the word has been used to describe a conscious experience of “ringing in the ears”. However, the sounds that are experienced are not exclusively reported as ringing, but vary substantially in terms of type, pitch and location. Sounds are commonly experienced as buzzing, hizzing, whistling, or cricket-like sounds, but people use a wide variety of descriptions to describe their experience (Stouffer & Tyler, 1990). The location also vary from person to person; the sounds that are experienced may be located in one ear, in both ears, somewhere in the head, or are even sometimes experienced as external to the head. In the scientific literature, tinnitus is commonly defined as the perception of sounds for which there is no identified external acoustic source (Lockwood et al., 2002). As stated in the introduction, it is common that individuals experience transient noises in the ears in association with a temporary hearing loss. The term prolonged spontaneous tinnitus has been used to differentiate between these
transient noises, which often occur in response to external sound, and tinnitus, which occurs for a longer period of time with spontaneous onset (Davis & El Refaie, 2000). However, there is no consensus concerning the criteria that differentiate the normal from the “pathological” forms of tinnitus (i.e., prolonged tinnitus). Some researchers have suggested that the symptom must exceed a 5-minute duration (Coles, 1983), or that it must occur for more than 5 minutes more than once a week (Dauman & Tyler, 1992). Yet, most will agree upon that tinnitus is typically experienced for longer periods of time and is present most of or all of time in the vast majority of cases (Henry, Dennis, & Schechter, 2005). Tinnitus can be considered chronic if the symptom lasts for more than 6 months (Davis & El Refaie, 2000), but no agreement has been reached in terms of criteria for longstanding or chronic tinnitus.

A common distinction is that between subjective and objective tinnitus (Dobie, 2004; Lockwood et al., 2002). The former refers to an experience of internal sounds only noticeable by the individual afflicted by the symptom, whereas the latter refers to noises that can be heard also by others. Objective tinnitus has been proposed to activate the cochlea physiologically through increased blood flow, muscular contractions or oto-acoustic emissions, producing sounds that often are audible to an external observer (Dobie, 2004). Not all have agreed to this distinction, claiming that tinnitus, by definition, is always a subjective experience (Henry et al., 2005). On the basis of the etiology of tinnitus, some researchers have instead proposed a distinction between neurophysiological and somatic tinnitus (Heller, 2003). Somatic tinnitus (or somatsounds) can indicate an underlying medical condition, including, for example, vascular lesions, middle-ear disease, or hypertension, which warrants further medical evaluations and treatment. Thus, the former distinction based on etiology might be more useful as it provides a classification that potentially can guide treatment choice. Furthermore, regardless whether an external observer may or may not hear sounds reported by the individual, tinnitus, by nature, is subjective.

Severity of tinnitus can refer to how loud the sounds are—for example, how easily tinnitus can be masked by external sounds—or the degree to which tinnitus affects normal functioning and quality of life, or both. Generally, however, severity of tinnitus reflects “nature and extent of patients’ tinnitus-related problems” (Meikle, 2003 p. 59). Using this definition, various dimensions of the experience of tinnitus (psychoacoustics, emotional, interference, concentrations problems etc.) can be included. Indeed, the diversity of difficulties reported by people with tinnitus was noted early on (Tyler & Baker, 1983). Yet, whether loudness (and other psychoacoustic aspects) should be included in the definition of tinnitus severity may depend on whether this as-
pect represents a significant “tinnitus-related problem”. This is not a clear-cut matter. Indeed, repeated testing using “objective” measures of psychoacoustics of tinnitus perception—for example, loudness of tinnitus can be measured by matching tinnitus loudness to external sound with similar frequency as tinnitus, or by measuring the minimal masking level of broadband noise needed to completely mask the sensation—have shown small or null correlations with degree of tinnitus impact (Tyler & Stouffer, 1989). Thus, from this research, it is clear that the dimension is empirically distinct from tinnitus-related problems, and should, accordingly, not be included in a concept that covers impact and quality of life. However, this might have to do more with how we measure these aspects. Intuitively, loud tinnitus can be challenging for anyone afflicted, and in clinical practice, several with tinnitus report significant problems in relation to perceived loudness of the sounds. Indeed, when it comes to subjective rated loudness and tinnitus impact, mixed results have been found (Henry & Wilson, 1995; Wallhäusser-Franke et al., 2012).

In the thesis, I will use the term tinnitus to refer to a subjective, prolonged experience of sounds in the ears in the absence of any appropriate external auditory source. The term tinnitus severity will be used to cover tinnitus-related problems in a broad sense, including emotional, cognitive, psychoacoustic and physiological aspects. Whether loudness and other psychoacoustic characteristics of the sounds are included in the concept depends on the context where it is used; that is, whether this aspect represents a significant tinnitus-related problem or not. To that end, generally, the term does not cover loudness of tinnitus, mainly because this aspect is unrelated to tinnitus-related distress (e.g., Wallhäusser-Franke et al., 2012). In the articles, and occasionally in the thesis, I will also use the term tinnitus distress, tinnitus impact, and global tinnitus severity. These concepts are interchangeable with tinnitus severity. The term tinnitus interference will, however, be used in a more narrow sense, referring to the degree to which tinnitus intrudes and disrupts performance (e.g., cognitive performance tests) or isolated activities.

Prevalence

As there is no consensus on how to define tinnitus, estimates of the prevalence have varied considerably across epidemiological studies (Henry et al., 2005). Methods used in these studies have also varied. For example, some studies have used structured interviews and random selected samples, whereas other studies have used self-report questionnaires and convenient samples. Several studies, however, have used the five-minute criterion of prolonged spontaneous tinnitus, have measured the phenomenon with at least one item,
and have used random population samples (Davis & El Refaie, 2000). Epidemiological studies have been conducted across the world, including United States, Europe, Asia, and Africa, making it possible to provide an overall estimate of the perceptual phenomenon worldwide. Across studies, epidemiological data indicate that prolonged spontaneous tinnitus in adults falls in the range between 10% and 15% (Davis & El Refaie, 2000; Hasson, Theorell, Westerlund, & Canlon, 2010; Landgrebe et al., 2012; Shargorodsky, Curhan, & Farwell, 2010). There is a clear trend of increasing prevalence at higher age decades (Hoffman & Reed, 2004). This phenomenon is most likely due to the relation between hearing loss and tinnitus. In fact, the majority of individuals with tinnitus have some degree of hearing loss (Axelsson & Ringdahl, 1989) and the prevalence of hearing loss increases with age.

A recent comprehensive Swedish study (N = 18 734) found that 28% among responders had tinnitus, and 11% reported that they experienced tinnitus often or all of the time (Hasson et al., 2010). This study also replicated previous findings indicating increasing prevalence with higher age. There is some evidence to suggest that incidence is rising as due to increasing noise exposure and aging population in the western part of the world (Henry et al., 2005). In particular, there is tentative evidence to suggest that tinnitus is increasing in young adults (Bulbul, Bayar Muluk, Cakir, & Tufan, 2009). However, longitudinal, prospective research studies using randomly selected nationwide population samples are scare, making it difficult to draw conclusions here.

A well-known fact is that the prevalence of tinnitus is much higher than the number of people who consider tinnitus to be a significant problem. To date, the most comprehensive epidemiological study (N = 48 313), which was undertaken by the UK Medical Research Council Institute of Hearing Research, reported a prevalence of tinnitus of 10%, but found that only 5% had moderately to severely annoying tinnitus (Davis & El Refaie, 2000). Moreover, in that study, 0.5% of the responders reported that tinnitus interfered with normal daily activities to such an extent that they were not able to live a normal life. An estimate of the prevalence of such severe cases of tinnitus falls in the range of 0.5% to 3% in the general adult population (Davis & El Refaie, 2000). Thus, approximately 1 in 10 experience tinnitus as a significant and debilitating condition. Accordingly, in the typical case people quickly adapt to these sensations and live healthy and productive lives despite of tinnitus. This fact is also mirrored in the low proportion of individuals among those with tinnitus who seek treatment or help for the condition (Henry et al., 2005). However, given that the symptom is extremely common, a substantial number of people will develop severe tinnitus and suffer immensely from the condition worldwide. Only in the United States, tinnitus will manifest a clinically significant condition in approximately 8 millions adults, with 2 to 3
millions reporting severely debilitating symptoms (Newman et al., 2011; Shargorodsky, Curhan, Curhan, & Eavey, 2010). Hence, tinnitus poses a significant problem for millions worldwide.

**Etiology and Mechanisms of Pathophysiology**

I differentiate between the cause as a potential trigger to the onset of tinnitus, i.e., etiology, and the basis for the cause or the pathological mechanisms underlying prolonged tinnitus generation. It is important to note that the term “cause” in this context is any event that may covary with tinnitus onset. There are many events that are associated with tinnitus, yet most cannot be proven to be “true” causal agents because it is impossible to rule out other third variables. In fact, several studies that have looked at “causes” have relied on retrospective self-report data. With this in mind, there are several candidates, events or potential causes that can lead to the onset of tinnitus (Baguley, 2002; Henry et al., 2005; Lockwood et al., 2002). One of the most common reported events that precipitate tinnitus is noise exposure. Various medications are also known to trigger the onset of tinnitus, including, for example, antimalarial drugs, birth control pills, antibiotics, to name a few. Others potential causes are aging, ear conditions, head and neck injury, infectious and vascular diseases. Emotional changes in the form of major life events or bereavement are also known to precipitate the onset of tinnitus.

Thus, trigger factors can vary considerable and tinnitus can arise without clear otological pathologies. Moreover, in the majority of cases the cause is identified as idiopathic. That is, participants cannot identify any event that preceded the onset of tinnitus. For example, Henry et al. (2005) reported questionnaire data from a sample of 2,369 patients with tinnitus who were treated at clinic in the United States and found that 40% reported that they could not identify any precipitating event. Among those patients who had a clear idea of the potential cause(s) of their tinnitus, a significant proportion reported noise exposure, closely followed by head and neck trauma or illness. In sum, although several cases of tinnitus are associated with otological pathologies, in the majority of cases no obvious otological trigger can be found and tinnitus is identified as idiopathic.

If little is known about potential causes to tinnitus, less is known about mechanisms underlying tinnitus generation at the physiological level. This is not to say that it has not been a topic of much scientific enquiry. In fact, numerous hypotheses of possible mechanisms have been postulated over the years (Baguley, 2002). The most influential theories have suggested changes or defects
involving inner and outer hair cells (Jastreboff, 1990; Kaltenbach, 2000), the auditory nerve (Eggermont, 1990; Möller, 1984), and the central auditory nervous system (Brozoski, Bauer, & Caspary, 2002). As noted by several researchers in the field (Baguley, 2002; Lockwood et al., 2002), given the heterogeneity observed among individuals with tinnitus, no single theory or model will suffice to explain the presence of tinnitus in all cases. Moreover, several mechanisms may play significant parts in the generation of tinnitus within a single individual, complicating matters even more.

Nevertheless, it is widely recognized the most common forms of tinnitus originate from changes in central auditory pathways following damages to auditory peripheral sites (Eggermont & Roberts, 2004; Jastreboff, 1990). Although animal models broadly give support to this notion, the location and nature of these changes are far from established (Eggermont & Roberts, 2004). However, it has been postulated that damage to some part or function of the cochlea play a significant role in the generation of tinnitus at an initial stage, mainly because sensorineural hearing loss is associated both with changes in the cochlea and onset of tinnitus in the majority of cases (Jastreboff & Hazell, 1993). In fact, even in the case when hearing thresholds are in the normal range, individuals with tinnitus can exhibit cochlear dead regions (Weisz, Hartmann, Dohrmann, Schlee, & Norena, 2006) or outer hair cell damages (Job, Raynal, & Kossowski, 2007), suggesting that tinnitus may originate from a initial cochlear pathology. Indeed, it has been suggested that the great majority of tinnitus cases involve damage to the sensory periphery (Hoffman & Reed, 2004) — though, in some cases damages are not extensive, resulting in only mild forms of hearing loss.

However, since tinnitus typically prevails following surgical section of the auditory nerve and given limited support for the assumption of increased spontaneous firing rates in auditory nerve fibers, it has been suggested that central auditory structures rather than peripheral sites, such as the cochlea, are the basis for tinnitus (Eggermont & Roberts, 2004). In other words, although potentially imperative for initiating a pathological reorganization of the central auditory system, the initial pathology does not explain sustained or chronic tinnitus. Rather, a prevailing assumption is that neuronal response properties changes following initial pathology and that these changes persist despite recovery from the peripheral lesion. These changes involve central structures at the cortical and subcortical level. According to the remapping hypothesis (Rauschecker, 1999), damages within a certain frequency range causes neighboring frequencies to become amplified as they expand into the damaged frequency range. Indeed, studies from PET and MEG studies support this assumption, by providing findings showing an expansion of the
frequency representation in the auditory cortex that corresponds to the perceived tinnitus frequencies (Lockwood et al., 1998).

More recently, much broader networks of neural plasticity has been proposed to be involved in the generation of tinnitus. Brain areas subserving emotion and attention may not only be activated as a consequence of emotional reactions to tinnitus, as previously proposed (Jastreboff, 1990), but play a more extended role in the perception of tinnitus. For example, Rauschecker, Leaver, and Mühlau (2010) suggested that although the auditory system may initially generate the tinnitus signal, limbic and paralimbic structures are involved in the cancellation of the signal. Others (e.g., Cacace, 2003) have turned to even broader multimodal networks to explain the mechanisms underlying tinnitus, potentially relevant in a subsample of cases where tinnitus can be modified by non-auditory sensory or sensorimotor system.

Tinnitus: The Problem

Tinnitus can be a serious health concern, with negative consequences for the individual and the society. It was recognized at an early stage that the effects of tinnitus were not primarily aural in nature (Fowler, 1948; Fowler & Fowler, 1955). Diversity of problems reported by those who suffer from tinnitus is substantial. Indeed, Tyler and Baker (Tyler & Baker, 1983) acknowledged this fact in a study that explored the difficulties caused by tinnitus, by stating that “Perhaps the most striking aspect of these findings is the diversity and gravity of the difficulties that were reported” (p. 152). Most common reported complaints associated with tinnitus are sleep disturbances, negative emotional reactions, and problems with concentration. In addition, auditory perceptual disorders, such as hearing problems or increased sensitivity to noise, are commonly observed in the group. In the following sections, I will summarize the research findings of some of the consequences associated with tinnitus.

Two things are important to bear in mind when we consider the research on the effects of tinnitus. First, complaints are not mutually exclusive and overlap to a significant degree. For example, sleep deprivation may result in concentration problems (cognitive functioning), which, in turn, may give rise to anger and frustration (emotional status) as well as increased sensitivity to
external or internal stimuli, including noise (auditory perceptual problems). Over time, this may evolve into a self-perpetuating cycle, making it difficult to disentangle one effect from another. Second, it is tricky to establish cause-effect relations between tinnitus and associated difficulties, and, in fact, causative relations are far from established. Thus, it is important to note that associations reported are correlational. For example, depression may be a consequence of tinnitus, may determine the degree of impact, or other predisposing factors (e.g., health anxiety, neuroticism) may cause tinnitus (or tinnitus severity) and depression to coexist. Indeed, multiple explanations have been given to the same association; it has been suggested that there are common/shared pathways in the pathophysiology of depression and tinnitus (tinnitus-related distress) (Langguth, Landgrebe, Kleinjung, Sand, & Hajak, 2011), that depression is a natural reaction to a chronic health condition such as tinnitus, and that preexisting depression (and other psychological problems) explain why certain individuals fail to adapt to tinnitus (e.g., Scott & Lindberg, 2000).

**Emotional and Psychiatric Problems**

The association between tinnitus and emotional distress is well established (Andersson, Carlbring, Kaldo, & Ström, 2004; Bartels, Middel, van, Staal, & Albers, 2008; Erlandsson, Hallberg, & Axelsson, 1992; Halford & Anderson, 1991; McKenna, Hallam, & Hinchcliffe, 1991; Zöger, Svedlund, & Holgers, 2001). Studies have shown associations between mood disorders and tinnitus as well as associations between affective disorders and tinnitus (Andersson, 2002). For example, Zöger et al. (2001) showed that 39% of a group of tinnitus patients (N=82) had an ongoing major depression disorder, and 45% had an ongoing affective disorder. Similar, or even higher, rates have been found in other studies (Andersson, Carlbring et al., 2004). On the basis of extent evidence, Andersson (2002) in a review reported that approximately 40% to 60% of individuals with clinically significant tinnitus meet criteria for anxiety and/or mood disorders. Thus, when compared with rates found in the general population, most studies conducted have reported a remarkably high proportion of individuals who have psychiatric problems among those with tinnitus (Andersson, Baguley, MacKenna, & McFerran, 2005).

However, as noted by Andersson, Baguley et al. (2005), such high rates of psychiatry disorders are most likely not found in the tinnitus population as whole. In fact, studies that have examined psychiatric disorders or anxiety/depression symptomatology in tinnitus have often used selected subsamples of individuals who were distressed by tinnitus and who sought
treatment for the symptom. Indeed, a couple of studies that have included both help-seeking and non-help-seeking individuals with tinnitus have found clear differences in terms of their psychological profiles, with help-seeking individuals experiencing more psychological and psychiatric symptoms than non-help-seeking individuals (Attias et al., 1995; Scott & Lindberg, 2000). Interestingly, in one of the studies it was reported that perceived loudness was rated as significantly lower in the help-seeking group than the non-help-seeking group (Attias et al., 1995), corroborating the finding that psychological aspects are far better predictors of tinnitus impact than audiological characteristics (Erlandsson et al., 1992; Hesser & Andersson, 2009; Newman, Wharton, & Jacobson, 1997; Wallhäusser-Franke et al., 2012).

Only a few population studies have been conducted examining both prevalence of tinnitus and associated psychological/psychiatric problems. In these studies, associations between generalized anxiety disorder (Shargorodsky, Curhan, Curhan et al., 2010) and depressive symptoms and tinnitus have been found (Krog, Engdahl, & Tambs, 2010). Shargorodsky et al. found that 20% of individuals who reported frequent occurring tinnitus also met criteria for generalized anxiety disorder, a proportion significantly larger than the proportion found in the general population in the United States (3%). Yet, contrary to the finding that was reported by Krog et al. 2010 who found that depressive symptoms was related to tinnitus, they could not establish that frequent tinnitus was associated with major depressive disorder. However, a recent longitudinal nationwide population study conducted in Sweden (Hébert et al., 2012), found that hearing loss was a better predictor of increased prevalence of tinnitus than depression over a time period of two years, but depression was a better predictor of increased tinnitus severity than hearing loss. Thus, the findings of Hébert et al. confirm the well-established distinction between prevalence of tinnitus and the severity of the symptom, and point to the importance of examining both aspects when considering potential risk factors in population studies of tinnitus. Nonetheless, results from a number of studies on emotional and psychiatric aspects of tinnitus suggest that tinnitus is associated with significant psychological distress in the form of anxiety and depression, at least among a subsample of individuals who perceive tinnitus as a health concern.

**Cognitive Functioning**

Studies that have investigated difficulties experienced by people with tinnitus with self-report instruments have found that a substantial percentage of individuals who suffer from tinnitus complain about poor attention and problems
with concentration (e.g., Sanchez & Stephens, 1997; Tyler & Baker, 1983; Wilson, Henry, Bowen, & Haralambous, 1991). More recently, a series of experimental studies of the effect of tinnitus on attention and memory has corroborated this finding (Andersson, Eriksson, Lundh, & Lyttkens, 2000; Andersson, Ingerholt, & Jansson, 2003; Hallam, McKenna, & Shurlock, 2004; Rossiter, Stevens, & Walker, 2006; Stevens, Walker, Boyer, & Gallagher, 2007). For example, Rossiter et al. (2006) reported results from two experiments that examined differences in performance on auditory verbal working-memory and visual divided-attention tasks between a group of participants with chronic tinnitus and a control group, matched for age, education and IQ. As hypothesized, participants with tinnitus performed worse on the tasks compared with the control group, a difference that was not attributable to individual difference of anxiety symptoms. It was concluded that the distraction effects of tinnitus, commonly reported by tinnitus sufferers, have a basis in performance tests, in particular tests that require voluntary, conscious and effortful control.

Indeed, in a review of the research, Andersson and McKenna (2006) reached similar conclusions and provided a model of tinnitus interference in which cognitive processes play a central role. However, the extent evidence rests on studies conducted by few separate research groups and that have used mixed samples of participants with tinnitus (Andersson & McKenna, 2006). In fact, it is difficult to control for various comorbid conditions that are commonly present in tinnitus, such as hearing loss, psychological problems, and increased sensitivity to noise. Nevertheless, although studies on topic suggest that individuals with tinnitus do experience some inefficiency in cognitive processing that cannot be attributed to emotional aspects of the experience alone, little is known about the nature or extent of these cognitive effects (Andersson, Baguley et al., 2005). In particular, much more work is needed to explore in depth how tinnitus may disrupt cognitive processes. With this in mind, one interesting study (Stevens et al., 2007) examined two alternative hypotheses on how performance on cognitive tasks may be affected by tinnitus: A general depletion of recourses hypothesis and controlled processing hypothesis. They compared performance on two Stroop tasks with different demands (high vs. low demand) in participants with severe tinnitus and a matched control group. Results confirmed the general depletion of resources hypothesis in that participants with tinnitus performed worse in both conditions of the Stroop task relative to controls. These results are broadly concurrent with the model proposed by Andersson and McKenna (2006) in which it was proposed that effects on tinnitus on information processing follows an inverted U-function; that is, tinnitus impairs performance on relatively undemanding tasks; has less of an effect on moderately demanding task; and it impairs performance, again, on very demanding tasks.
Another interesting idea on how tinnitus may affect cognitive processes in tinnitus, is the “changing-state character” hypothesis (Andersson & McKenna, 2006). It states that changing character of the tinnitus signal, due to varying environmental background sounds or due to that the tinnitus signal in it self varies, is what causes tinnitus to attract attention, and as such, deplete working memory resources. This assumption is predominately based on the well-established phenomenon that an auditory stimulus that changes in pitch adversely affects cognitive efficiency (Jones & Macken, 1993). However, although this is a plausible hypothesis, so far, little work has provided support to this fact in tinnitus.

**Sleep Disturbances**

As noted by several researchers (e.g., Sanchez & Stephens, 1997; Tyler & Baker, 1983), problems with sleep are one of the most common complaints among individuals with tinnitus. Indeed, a substantial amount of scientific literature supports this fact and sleep difficulties has been regarded as a significant risk factor for the development of tinnitus-related distress (Holgers, Erlandsson, & Barrenas, 2000; Langenbach, Olderog, Michel, Albus, & Köhle, 2005). A rough estimate is that approximately 25% to 50% of individuals with clinically significant tinnitus experience some form of sleep problem (Andersson, 2002). Despite the fact that it has been argued that mood alone cannot be attributed for the presence of sleep problems reported in the group (Hallam, 1996), studies have found associations with sleep problems and depression (Alster, Shemesh, Ornan, & Attias, 1993), as well as sleep difficulties and tinnitus-related distress (Folmer & Griest, 2000). Furthermore, sleep problems are more common in help-seeking individuals than non-help-seeking individuals (Scott & Lindberg, 2000), but mixed findings have been reported on whether hearing loss moderates the association between sleep difficulties and tinnitus (Folmer & Griest, 2000; Hallam, 1996).

Although the association between self-reported sleep difficulties and tinnitus is undisputable, only a few studies have used comprehensive sleep questionnaires (e.g., Asplund, 2003; Hallam, 1996), and even fewer have used physiological measures of sleep disturbances. Furthermore, most studies have not included matched control groups. There are some exceptions though. For example, one study matched tinnitus participants for health and socioeconomic status and found that participants with tinnitus reported greater sleep difficulties than matched control subjects and that elevated tinnitus-related distress was associated with greater sleep difficulties (Hébert & Carrier, 2007). Another study (Cronlein, Langguth, Geisler, & Hajak, 2007) compared
individuals who had problems with both insomnia and tinnitus with age- and sex-matched individuals with insomnia only on physiological and subjective sleep measures, and on cognitive performance tests. With the exception that participants with both tinnitus and insomnia had longer sleep latencies than participants with insomnia only, results provided little evidence to any qualitative differences between the groups (Cronlein et al., 2007). The authors concluded that similar mechanisms may underlie tinnitus patients with insomnia and “ordinary” insomnia patients, and that established treatments for insomnia should be used to treat insomnia in patients with tinnitus.

Impact on Society

While an abundance of literature has been published on the consequences of tinnitus on the individual level, less is known about if and how tinnitus constitute a problem at the level of society. For example, to date there are no studies that have quantified the overall economic impact of tinnitus. In fact, this task is difficult given that such an estimate would need to include several aspects, including loss of job productivity, medical costs, treatments, and compensations. Yet, Henry et al. (2005) provided data from the U.S. department of Veterans Affairs, which regards tinnitus as a debilitating condition for which veterans can submit claims in order to obtain monetary compensation. On the basis of these data, Henry et al. concluded that the costs of tinnitus are most likely substantial. A more recent estimate of the annual disability compensation by the Department of Veteran’s Affairs for tinnitus exceeded USD $2 billion in 2009 (reported in Landgrebe et al., 2012).

Furthermore, a large prospective Swedish study ($N = 4,687,756$, aged 20-64 years) demonstrated an increased risk of disability pension among those with sickness absence due to tinnitus (Friberg, Jansson, Mittendorfer-Rutz, Rosenhall, & Alexanderson, 2012). In fact, the risk increased threefold as compared with other diagnosis. An important finding was also that the risk of disability was highest in the age group 35 to 44 years, an age span where people ought to be most productive. Moreover, as noted earlier, tinnitus is frequently accompanied by affective and mood disorders, which, in turn, are associated with great financial costs (Smit et al., 2006). For example, generalized anxiety disorder, which was found to be associated with tinnitus in a large populations study in the United States, has been associated with great financial burden for society in terms of, for example, loss of work productivity and health care costs (Wittchen, 2002). Collectively, despite little research in the area, tinnitus is most likely associated with a great financial cost for society.
TREATMENTS FOR TINNITUS

Treatments

Treatments for tinnitus can have two basic aims: 1) to eliminate tinnitus or change its sensory qualities (e.g., reducing loudness), or 2) to reduce negative consequences of tinnitus (e.g., changing the impact of the sounds on functioning and health). Treatments that target the first aim will not be considered here because, at present, if no clear underlying treatable ear disorder can be identified, no available treatment can provide a permanent cure (Lockwood et al., 2002). It should be noted, however, that the aims are not mutually exclusive. For example, antidepressant may act on the central auditory system that indirectly changes how auditory stimuli is processed in the brain or a phenomenon known as residual inhibition in which tinnitus temporary disappears may occur following masking of the tinnitus sound (Vernon & Meikle, 2000). Moreover, given that there some evidence to suggest an association between subjective rated loudness and tinnitus severity, it seems plausible that any treatment that successfully changes impact and severity also alters the perceptual aspects of the sensation. Yet, to date, the evidence has provided little support to this assumption. For example, CBT has repeatedly shown to be effective in the treatment of tinnitus severity, but positive effects on loudness has not been established in controlled trials (Martinez-Devesa et al., 2010), and psychological variables have been found to be far better predictors of tinnitus-related distress than psychoacoustic features of the sounds (Wallhäusser-Franke et al., 2012).

Available Treatments

Available treatments for the management of tinnitus vary substantially. These include sound therapies, pharmacological treatments, electrical stimulation of the brain, psychological approaches, hearing aids/cochlea implants, to name the most common forms of treatment. Numerous therapies have been subject to scientific scrutiny in randomized controlled trials, but efficacy beyond mere placebo response has been difficult to demonstrate (Dobie, 1999). Although it has not yet been systematically investigated, the placebo response in tinnitus may be substantial. Indeed, we recently performed a meta-analysis on wait-list control groups in tinnitus and found a small but significant reduction in severity over short period of time (5-10 weeks) across studies (Hesser, Weise, Rief, & Andersson, 2011). Thus, any treatment that aim to ameliorate the suffering caused by tinnitus, including pharmacological and surgery, may also affect illness behavior, expectations, and appraisals of the experience, making it difficult to disentangle such effects from treatment-specific effects.
Fowler and Fowler (1955) made this observation at an early stage: “Anything which eases the emotional strain, anything which enables the patient to function better in the hearing world, will in the great majority of instances lessen the annoyance from tinnitus, or remove it from consciousness by making it subaudible”.

In fact, at present, the specific effects of any form of treatment for tinnitus has not been demonstrated sufficiently—with the only exception of CBT, but, as I will argue later on, the effect is not specific enough. A recent study (Hoare, Kowalkowski, Kang, & Hall, 2011) reviewed the extent evidence for tinnitus management strategies suggested by the Good Practice Guide provided by the Department of Health in the UK. The review included hearing aids, pharmacological agents, sound therapies, and psychological treatments (CBT, relaxation therapy, counseling). The authors concluded that, with the exception for therapist-delivered CBT, none of the other interventions provided reasonably support to be efficacious. Indeed, they came to similar conclusions as an earlier review with similar aim (Dobie, 1999), and stated disappointed the following, “…more than 10 years on, although we have greater RCT-level evidence and some opportunities for meta-analysis, there is still little evidence for the efficacy of most recommended treatment strategies” (Hoare et al., 2011, p. 1563).

In sum, although a wide range of therapies have been proposed and scientifically examined for the treatment of tinnitus, the evidence has not been kind. In the following sections, I will give a brief overview of the research on two of the most commonly used strategies in the management of tinnitus in clinical practice: Sound therapies and antidepressants. I will then devote an entire chapter on CBT for tinnitus.

### Antidepressant Treatments

Given the known associations between psychiatric problems, such as depression and anxiety disorders, and tinnitus, it is not surprising that there is a growing interest to examine psychoactive drugs for tinnitus. Similar to the debate on causative relations between psychological disturbances and tinnitus, there is also a debate regarding whether antidepressants act on the central auditory system, act by treating the concomitant depression, or have an effect on both depression and tinnitus (McFerran & Baguley, 2008). The idea that antidepressants achieve their effect by directly modifying the central auditory system is supported by the literature showing that auditory pathways are rich in serotonin receptors (Robinson, Viirre, & Stein, 2007). More recently, it has
been argued that depression and tinnitus activate similar neural circuits and to a large extent share pathophysiology (Langguth et al., 2011), suggesting that similar mechanisms can be targeted in the treatment of both conditions. However, others have argued that when antidepressant work, they do so by addressing accompanied psychological problems (Parnes, 1997), and that have led to that some researchers have recommended that tinnitus patients with major depression should be considered for antidepressant therapy (Dobie, 2003).

Tricyclic antidepressants (amitriptyline, imipramine and nortriptyline) and serotonin-specific reuptake inhibitors (SSRIs; paroxetine) have been used to treat tinnitus in controlled trials. In a Cochrane review (Baldo, Doree, Lazzarini, Molin, & McFerran, 2006), 6 randomized placebo controlled trials with a total number of 610 participants were identified in systematic searches; 4 examined the effect of tricyclic antidepressants; 1 SSRI; and 1 an atypical antidepressant, trazodone. It was concluded that none of the included studies was conducted with a high methodological rigor, with the exception of the SSRI trial. In that trial, there were no clear benefits of the active drug over placebo in terms of primary (i.e., disability and impact of tinnitus) or secondary outcomes (i.e., tinnitus perception, depression or anxiety), with the exception for a possible benefit for a subgroup that received higher doses of the active drug on disability due to tinnitus. Yet, the final conclusion that was reached in the review was that there is yet insufficient evidence to support antidepressant drug therapies for tinnitus.

Sound Enrichment/Masking Treatments

One of the most commonly applied means of dealing with the intrusiveness of tinnitus has been to use sound to partly or completely mask tinnitus (Vernon & Meikle, 2000). The purpose is to make tinnitus inaudible, change its characteristics, or to facilitate habituation to tinnitus through sound enrichment. Sound therapy was first introduced on the principle of “completely masking” whereby the sound masking noise was played in such intensity that the tinnitus signal was made inaudible. However, subsequent research during the 1980s promoted a shift in the way masking therapy was delivered (Penner, 1983; Stephens & Corcoran, 1985; see also Vernon & Meikle, 2000); rather than using noise that completely masked tinnitus, sound treatments started to use a low level of white noise. This change in protocol stemmed from several research observations and theoretical assumptions.
First, a large proportion of individuals did not accept devices, especially if masking sounds needed to be raised to uncomfortable levels to mask tinnitus (Vernon & Meikle, 2000). Second, it was argued that if the patient could not hear the sound then he/she would not be able to habituate to tinnitus (Jastreboff & Jastreboff, 2000). Third, the overall purpose with the strategy changed from residual inhibition/distraction to “sound enrichment”; it was argued that white noise acts as a source of stimulation to central auditory system to compensate for loss of auditory stimulation. This was based on the assumption that tinnitus arose as a consequence of sensory deprivation.

These latter ideas were mainly based on Jastreboff’s conceptual theoretical framework for tinnitus, i.e., the neurophysiological model of tinnitus (Jastreboff & Hazell, 1993). Tinnitus Retraining Therapy (TRT), a sound therapy that has received considerable amount of attention within audiology, has its theoretical origin in the neurophysiological model. In this treatment, noise generators are adjusted so that patients can hear both their tinnitus and the external noise at the same time, and sound therapy, including broad-band ear-level generators and environmental sound enrichment, is administrated according to a protocol based on particular patient categories over a course of 24 months. In addition, the treatment consists of directive counseling where patients are educated about the auditory system and the purported mechanisms underlying tinnitus generation (Jastreboff & Hazell, 2004).

Two recent Cochrane reviews have examined the efficacy of sound therapy and TRT. In the review on sound therapy (Hobson, Chisholm, & El Refaie, 2010), a total of 6 trials, comprising 533 participants, were included and outcomes were changes in loudness or severity/impact on quality of life. The authors concluded that limited evidence precluded firm conclusions, primarily due to the lack of quality research in the area. In the review of TRT (Phillips & McFerran, 2010), only one, low-quality trial was included and that trial compared TRT with sound masking, showing clear beneficial effects of TRT compared with tinnitus masking on tinnitus disability. Thus, it appears that the evidence provides little support to these interventions, although, as pointed out by the authors of the review on sounds therapy, the absence of evidence should not be interpreted as lack of effectiveness. On the other hand, on the basis of the extent evidence, we cannot conclude that these interventions are effective in the management of tinnitus. Indeed, a couple of trials that have isolated the effect of sound generators, have found no added effect of these interventions (Bauer & Brozoski, 2011; Hiller & Haerkotter, 2005).
Cognitive Behavior Therapy for Tinnitus

That idea that tinnitus can be successfully managed with psychological interventions is not a new one. In 1831, J. H. Curtis was one of the first to suggest that psychological factors are of importance in the treatment of tinnitus (Stephens, 1984). Over the years, as tinnitus has presented a challenge for the medical community in terms of treatment, the notion has been widely accepted within the scientific community and a wide variety of psychological approaches have been proposed.

The first to be tested systematically were different forms of relaxation therapies, including hypnotherapy (Brattberg, 1983; Marlowe, 1973), biofeedback training (Haralambous et al., 1987; House, Miller, & House, 1977), and progressive relaxation (Ireland, Wilson, Tonkin, & Platt Hepworth, 1985). Although these initial research efforts were overall encouraging, mixed results were presented in support to the effectiveness of relaxation as a single intervention for the treatment of tinnitus. However, stemming from this work and initial research on cognitive techniques (Jakes, Hallam, Rachman, & Hinchcliffe, 1986), it was argued that treatments that combined relaxation and cognitive interventions could be a viable alternative (Scott, 1989). In the early 1980s, the first controlled trials of behavioral and cognitive behavioral approaches emerged in the scientific literature (e.g., Lindberg, Scott, Melin, & Lyttkens, 1988; Scott, Lindberg, Lyttkens, & Melin, 1985).

CBT is, by far, the most well documented and researched psychological treatment for tinnitus (Henry et al., 2005). The term CBT covers a broad array of different treatments. Thus, contrary to common held beliefs about CBT, it is not one form of treatment. This is true for CBT in general as well as CBT for tinnitus. In fact, behavioral and cognitive behavioral treatments for tinnitus can include a wide variety of procedures, including applied relaxation, exposure to the sounds, education and advice regarding tinnitus and related auditory problems, sound enrichment, cognitive restructuring, positive imagery, biofeedback, and techniques for sleep disturbances (Andersson, 2002; Henry & Wilson, 2001). Thus, CBT protocols for tinnitus can consist of any combination of these procedures or be based on one or two procedures (e.g., Scott et al., 1985). So what are the essential components of CBT? In essence, CBT for tinnitus aims to change dysfunctional behaviors, thoughts and/or emotional reactions to tinnitus by using a behavioral or cognitive procedure or any combination of behavioral or cognitive procedures. Thus, it is often defined broadly based on the procedures used; Yet, CBT in general has been remarkably difficult to define primarily because the treatment rests on several distinct treatment traditions and philosophical foundations (Hayes, Villatte, Levin, & Hildebrandt, 2011). Yet, when it is defined, a key focus has often
been on altering cognitions or attention processes: “CBT is based on the notion that behavioral and emotional responses are strongly moderated and influenced by cognitions and the perception of events” (Hofmann & Asmundson, 2008, p. 3).

**Origin of CBT and Theoretical Underpinnings**

Earlier I alluded to the fact the CBT for tinnitus developed as a consequence of unsatisfactory treatment results. Indeed, Sweetow (1995) stated the following in an article in which he described the evolution of CBT for tinnitus:

“The implementation of a cognitive behavioral component to my tinnitus-patient management protocol over a decade ago was encourage by two factors: (1) frustration with the failures of long-term relief from other procedures; and (2) the desire to provide short-term immediate relief” (p. 64).

In addition, it was most likely the failure of single-procedure interventions (e.g., bio feedback) that promoted the development of CBT. Scott (1989) in her dissertation cited Azrin (1977), one of the fathers of behavioral therapy, when she provided a rational for treatment development: “My strategy has been to use such programs unapologetically and to include as many component procedures as seem necessary to obtain, ideally, a total treatment success” (p. 144). Furthermore, the decision to integrate CBT into tinnitus management was also based on that CBT had, at that time, been successfully used for patients with chronic pain (Henry & Wilson, 2001; Scott et al., 1985; Sweetow, 1995), a condition that bares many similarities with tinnitus (House & Brackmann, 1981; Möller, 2000). Thus, rather than having been informed by specific theories of tinnitus, the treatment developed pragmatically through observation and study of response to intervention.

However, one theory that has influenced CBT, and was developed parallel to the implementation of CBT into tinnitus management, is Richard Hallam’s model of tinnitus interference (Hallam, 1986; Hallam, Rachman, & Hinchcliffe, 1984), often referred to as the Psychological Model of tinnitus (McKenna, 2004). Although several other researchers had proposed that psychological strain influence the experience of tinnitus, the theory represented a first attempt to explain the psychological processes involved in tinnitus distress. On the basis of the observation that most people adapt to the sensation, it was proposed that the normal developmental process was habituation to tinnitus. It was suggested that this adaption process in tinnitus is fundamental-
ly similar to the adaption to any other stimulus, and should follow the rules of (dis-) habituation. Generally, Hallam and colleagues pointed to impaired selective sensory inhibition due to an overactive central nervous system in the dishabituation scenario: “under normal circumstances there is a uniform habituation to meaningless stimuli (i.e. filtering), but, under certain conditions, changes in stimulus input leads to both orienting and emotional responses and an increase in phasic arousal” (p. 44).

Specifically, Hallam and colleagues suggested that the habituation process will be delayed if one is experiencing high levels of tonic arousal, if the sound is particular intense, aversive, and unpredictable, or if it acquires emotional significance through a learning process. Furthermore, an orienting response to tinnitus will interrupt the “natural” habituation process. It is suggested that this will disrupt ongoing activity and increase awareness of the sensations, which in turn may increase arousal level, creating a feedback loop that interferes with the adjustment. Unfortunately, the founders of the model did not offer precise details of particular processes that might be involved here, and, perhaps as a consequence, the model has not enjoyed more than anecdotal empirical support (McKenna, 2004). Nevertheless, the model provided a theoretical framework for CBT (Andersson, 2002; Henry & Wilson, 2001; McKenna, 2004). That is, treatments can facilitate habituation to tinnitus by reducing levels of autonomic nervous system arousal, changing emotional meaning, or by decreasing attention to/preoccupation with the sound. Specifically, applied relaxation can be used to decrease arousal level and distraction techniques, imagery, and cognitive restructuring can be used to change attention bias, negative thoughts, and beliefs in relation to tinnitus (Andersson, 2002; Henry & Wilson, 2001). Yet, whether the therapies achieve their effect through these mechanisms has, to my knowledge, never been tested empirically.

**Effectiveness**

As previously stated, CBT is probably the treatment, regardless of modality, that has been most rigorously examined in controlled trials and has received most support to be efficacious in the treatment of severity and disability due to tinnitus (Hoare et al., 2011). A Cochrane review (Martinez-Devesa et al., 2010), which was recently updated and included 8 trials, concluded that CBT for tinnitus had no effect on subjective loudness but a significant effect on global tinnitus severity. However, the systematic review had a number of limitations. First, the review had specified loudness as the primary outcome, which seemed illogical given that primary goal of psychological treatment is
to improve a person’s well being and quality of life and reduce the negative impact of tinnitus rather than to affect loudness directly. Second, it had wrongly excluded a number of studies. Third, it seemed premature to conclude that the treatment had strong support given that the control conditions that were used in the trials were less than optimal. Fourth, no data from follow-up were reviewed and no moderator analyses were conducted. Furthermore, there were some miscalculations.

For these reasons, we conducted a new systematic review and meta-analysis of randomized controlled trials of CBT for tinnitus (Hesser, Weise, Westin, & Andersson, 2011). In this review, we included any controlled trial that had investigated a treatment that had a substantial component of cognitive-behavioral, cognitive or behavioral methods, and we used global tinnitus severity as the primary outcome. We identified a total of 15 studies that met our inclusion criteria. We found a moderate to large effect size when treatments were compared with wait-list control conditions (Hedges’ g = 0.70), and small to moderate effect size when they were compared with active control conditions (Hedges’ g = 0.42), which included sound therapy, relaxation, yoga and education. Uncontrolled follow-up data indicated that gains were maintained. We performed a number of sensitivity analyses that did not seem to influence the findings and characteristics of studies were unrelated to the effects obtained. Taken together, the results were fairly positive and we reached similar conclusions as the Cochrane review, as well as those reached in the general review on tinnitus management (Hoare et al., 2011).

A study recently published in the medical journal the Lancet (Cima et al., 2012), reported results from the largest randomized controlled trial of a CBT-based protocol for tinnitus to date (N = 492). The results were almost identical to those reported in our meta-analysis: They found an effect size of Cohen’s d = 0.43 and d = 0.45 for tinnitus severity and impairment, respectively, when CBT was compared with treatment as usual. Thus, taken together, is seems fair to conclude that CBT, broadly defined, seems to produce positive effects beyond mere emotional support and attention.

It should be noted, however, that none of the studies included in our review met criteria for a high methodological rigor. Most important, the active control conditions could not control for all unspecific effects (e.g., therapist time). Furthermore, although the effects were homogenous across studies, the treatment protocols were not. That is, some protocols were primarily based on behavioral procedures, others where primarily based on cognitive techniques, and others yet used a combination of both. Furthermore, some treatments have been incorporated into larger multidisciplinary treatment regimes that have used a wide variety of interventions. For example, the trial by Cima et
al. (2012), in addition to using various CBT-interventions, the treatment included almost the entire TRT protocol, including directive counseling and sound generators, as well audiology rehabilitation. Such RCTs give us little information about which specific procedures that actually are beneficial in CBT. Indeed, I recently argued that the high methodological value associated with RCTs, can make researcher loose track of what they actually are testing in the randomized experiment (Hesser, 2010). That is, if our independent variables are poorly operationalized in RCTs and our control conditions cannot rule out alternative explanations, these research efforts provide little useful knowledge. Only a handful of studies have directly compared different CBT-based procedures for tinnitus (Henry & Wilson, 1998; Jakes, Hallam, McKenna, & Hinchcliffe, 1992; Lindberg, Scott, Melin, & Lyttkens, 1989). Unfortunately, these studies have generally been of low methodological quality and have been greatly underpowered to detected clinically meaningful differences.

Moreover, despite that three independent meta-analysis have reached similar, if not identical, conclusions, there is room for improvement in the outcomes. Indeed, approximately 30% to 50% meet criteria for clinically significant improvement after CBT (Andersson, Porsaeus, Wiklund, Kaldo, & Larsen, 2005; Andersson, Ström, Ström, & Lyttkens, 2002; Kaldo et al., 2008; Weise, Heinecke, & Rief, 2008), leaving a substantial proportion of individuals suffering from the symptom.

Another related issue is effectiveness. Effectiveness refers broadly to the extent to which an established treatment holds up in clinical practice. That is, whether interventions that have been proven efficacious in well-controlled experimental designs can be transported into naturalistic settings (Shadish, Matt, Navarro, & Phillips, 2000). Specifically, it poses questions about whether patients, therapists and treatments used in research settings, are representative or relevant to routine clinical practice (Stewart & Chambless, 2009). True effectiveness studies in tinnitus are rare (Kaldo-Sandström, Larsen, & Andersson, 2004). Only a few studies have recruited patients from clinical practice settings (Hesser, Weise, Westin et al., 2011) or have been conducted in naturalistic settings. More important, studies have almost exclusively used psychologists as providers. Hoare et al. (2011) identified no study where CBT was delivered by an audiologist or hearing therapist, and noted that this was an unfortunate fact, given limited availability of clinical psychology in tinnitus management settings. A recent study, conducted in the UK (Gander, Hoare, Collins, Smith, & Hall, 2011), found that only 35% of clinicians among audiology staff reported that patients had access to specialists counseling provided by clinical psychology. Although no data have been provided to support the claim, evaluated CBT-protocols are most likely even
more rarely offered to patients in routine clinical practice. Thus, despite established efficacy of CBT for tinnitus, most patients seen in regular practice do not receive these interventions. Furthermore, it remains to be seen whether CBT delivered in regular health care, using regular providers, is a viable approach to the management of tinnitus.

**A New Delivery-Format: Self-help delivered via the Internet**

Guided internet-delivered self-help treatment has been suggested as one way to disseminate empirically validated therapies, as the treatment format has the potential to reach people who otherwise will not receive access to evidence-based health care (Andersson, 2009; Andrews, Cuijpers, Craske, McEvoy, & Titov, 2010). Although definitions vary, guided internet-delivered self-help has been defined as “an approach which combines the advantages of structured self-help materials, presented in an accessible fashion via the internet, with the important role played by an identified therapist who provide support, encouragement and occasionally direct therapeutic activities via e-mail” (p. 175, Andersson, 2009). A wide variety of internet-delivered treatments have been evaluated, most of them have used some form of CBT-based protocol. Internet-delivered CBT is frequently delivered in a way that resembles how face-to-face CBT is delivered in terms of both content and structure (Andersson, 2009). That is, it is structured, time-limited therapy in which the client works with homework assignments. It is often based on self-help texts of CBT for particular disorders or health conditions and the treatment texts are frequently divided into chapters, similar to how manualized CBT protocols are divided into sessions. The role of the therapist is to provide encouragement and support throughout treatment and to give feedback on homework assignments as well as to grant the patient access to new self-help texts with associated assignments. Communication is often asynchronous, i.e., patient is not concurrently engaged in communication with the therapist; rather, the patient sends messages to the therapist, using, for example, e-mail or online messages platforms, at the most convenient time over the course of the day. Although current evidence suggests that the identified therapist play an essential role in internet-delivered treatments (Andersson, 2009), the time spent by therapist for each patient is substantially reduced as compared with face-to-face therapy. Therapists usually spend approximately 10 to 20 minutes per week and patient (e.g., Ljótsson et al., 2011).

Over the last decade, an impressive body of empirical work on internet-delivered CBT has been accumulated. Systematic reviews and meta-analyses of controlled trials (Cuijpers, Donker, van Straten, Li, & Andersson, 2010; Cuijpers, van Straten, & Andersson, 2008) have provided support to the de-
livery format in the treatment of a wide variety of health conditions and psychiatric disorders, including, for example, social anxiety disorder, panic disorder, depression, irritable bowel disorder, health anxiety, pathological gambling, among others. Most relevant, several trials have been conducted on tinnitus, showing positive outcomes in treating severity associated with the symptom (Andersson, Porsaeus et al., 2005; Andersson et al., 2002; Kaldo et al., 2008). In fact, similar results have been provided for internet-delivered CBT for tinnitus as face-to-face CBT when compared directly in a controlled trial (Kaldo et al., 2008), and beneficial outcomes have also been detected when internet-delivered treatment has been used in a regular-health care setting (Kaldo-Sandström et al., 2004). Thus, guided internet-delivered CBT seems to be viable alternative to traditional methods of delivering CBT, and has the potential to increase access to psychological interventions that are rarely available in routine clinical practice.

CBT for Tinnitus: Concluding Remarks

Rather than having been informed by theory, CBT for tinnitus developed pragmatically. Techniques were borrowed primarily from CBT for chronic pain given the similarities between the two conditions (Henry & Wilson, 2001). Tested protocols have most often consisted of a combination of behavioral and cognitive procedures. Despite the lack of theoretical developments and basic research in the area, the record of results for these approaches to management of tinnitus over the last 20 years is impressive, especially when you consider it in the light of the repeated failure of other approaches. Indeed, CBT is at present the most empirically validated treatment and new delivery formats have the potential to improve dissemination of CBT.

However, there is a downside: a substantial proportion of people who are suffering do not benefit from these treatments; we do not know for whom they work or under what circumstances they work; and we do not known the specific procedures that are effective or the processes by which these procedures achieve their effect. This should be a concern. The challenging is to move forward and to develop better treatments. To do this, we may need to return to the theoretical level; develop treatments that are based on theory-driven intervention procedures; and focus not only if these procedures work but on how these procedures achieve their effect. The current thesis project represents such an attempt. In the following section, I will outline the theoretical and philosophical framework.
Outlining a Research Program for the Development of CBT

We have yet to develop sufficiently efficacious treatment for tinnitus. CBT has enjoyed success at large, but it seems fair to say that we do not know where to go from here. Ideally, new procedures are extensions of theoretical principles derived from basic science (Hayes & Shenk, 2004). As the behavioral and cognitive therapies for tinnitus developed pragmatically, and as the theoretical foundation was weak, it is difficult to confirm or disconfirm any particular procedure. We may need to return to theory to specify the processes that then can be examined empirically. In so doing, a particular procedure can be evaluated on the basis of whether it changes the processes of interest, and whether a predefined outcome is produced as a direct consequence of changes in the targeted processes. This is most likely not an easy or quick solution; it will require time and significant effort. Yet, as argued by several preeminent researchers (e.g., Hayes, 2005; Kanter, 2011; Kazdin, 2007), it may well be critical to the progress of the field of clinical psychology at large. This is probably true for CBT for tinnitus as well. The current thesis project rests on this assumption of scientific progression.

In the following sections, I will clarify the philosophical assumptions and the scientific strategy that underlie my thesis project. I begin, however, with the theoretical framework that will be used to expand the cognitive behavioral tradition in the treatment of tinnitus.

Acceptance and Mindfulness: An Emerging Trend in CBT

It has been proposed that behavioral and cognitive therapies can be organized into different perspectives in terms of scientific goals and procedures depending on time era (Hayes, 2004a; Hayes, Villatte et al., 2011). In the early years, from the 1960s, behavior therapy was predominately based on various forms of stimulus-response (S-R) or operant learning theories. Behavior therapies were concerned with developing applications of experimentally established principles of learning to address behavioral problems. In the later part of the century, behavior therapy incorporated a cognitive dimension and emphasized cognitive/attention processes and social learning as integral parts of the therapy process (Hayes, 2004a). Therapies focused to a larger extent on changing the content or form of irrational beliefs or thoughts through the means of cognitive restructuring and behavioral experiments. According to Hayes, the frontal figure of this treatment development was Aaron Beck: “Cognitive therapy is best viewed as the application of the cognitive model of a particular disorder with the use of a variety of techniques designed to modify the dys-
functional beliefs and faulty information processing characteristic of each disorder” (Beck, 1993, p. 194).

It has been argued that this “cognitive revolution” within behavior therapy weakened the link to basic science: Rather than using empirically derived principles to guide treatment, theoretical models were developed in clinical setting on the basis of a mechanistic view on syndrome disorders (Hayes, 2004a). According to Hayes (2004a; Hayes, Villatte et al., 2011) along with philosophical changes and anomalies in the research on the change models in traditional CBT—research provided little evidence to that cognitive components and processes were causally linked to outcome in cognitive therapies (Jacobson et al., 1996; Longmore & Worrell, 2007)—this set the stage for a so called “third wave” of cognitive and behavioral therapies. Despite being part of the CBT-tradition, these therapies to a larger extent focused on processes such as acceptance and mindfulness. The development also included a shift from content to context; that is, thoughts and feeling were considered situated events and their function could change without affecting their frequency or form. Said in another way, treatments focused on altering the relationship with thoughts or feelings rather than the form or the content of these events. Indeed, they have for that reason alone been called “contextual cognitive behavioral therapies” (Hayes, Villatte et al., 2011, p. 141). Therapies also shared a common goal of developing empirically derived principles and processes. Moreover, instead of focusing on syndrome or disorders, they also shared a goal of developing broadly effective behavioral patterns, rather than eliminating problematic behaviors or cognitions.

**Acceptance and Commitment Therapy**

Acceptance and Commitment Therapy (ACT, Hayes, Strosahl, & Wilson, 1999) is by far the most researched of the “new” contextual cognitive behavioral therapies. Independent meta-analyses have provided support for the usefulness of ACT in treating a wide variety of health conditions (Hayes, Luoma, Bond, Masuda, & Lillis, 2006; Powers, Zum Vorde Sive Vording, & Emmelkamp, 2009; Öst, 2008). Indeed, encouraging results from controlled trials have been provided for very distinct problems, including work stress, psychosis, obsessive compulsive disorder, trichotillomania, smoking, chronic pain, anxiety, and depression. Comparison conditions have included cognitive therapy, behavior therapy, attention placebo, psychoeducation, treatment as usual, and wait list. Across problem areas, meta-analyses have provided between group effect sizes ranging between Cohen’s $d = 0.42$ and $d = 0.66$ (Hayes et al., 2006; Powers et al., 2009; Öst, 2008). In addition, an accumu-
lating body of research, including experimental component and mediation analysis, has provided support to the purported processes of therapeutic change (see, Hayes, Villatte et al., 2011; Levin, Hildebrandt, Lillis, & Hayes, 2012, for reviews). Most significantly, a growing number of studies that have directly compared traditional CBT with ACT have found support for that ACT works through distinct processes of change (e.g., Flaxman & Bond, 2010; Forman et al., 2012).

The evidence base for contextual-based cognitive behavioral therapies and associated processes is steadily increasing, in particular for ACT (Ruiz, 2010). It should be noted, however, that there are few direct comparisons between traditional CBT and ACT. Furthermore, the treatment has been criticized on both methodological (Öst, 2008) and theoretical grounds (Hofmann & Asmundson, 2008). Yet, overall, it has enjoyed successes, in particular when you consider the research on chronic pain, which I will do in the next section.

ACT is rooted within the behavioral tradition and was initially proposed to be an exposure-based therapy (Hayes, Levin, Plumb, Boulanger, & Pistorello, 2011; Twohig et al., 2010). The therapy teaches clients to stay in contact with difficult internal experiences and encourage them to approach and make room for these sensations without resorting to control or avoidance strategies. However, the primary goal of the treatment is not to decrease maladaptive responses (e.g., anxiety), as traditional exposure-based therapies, but to develop a flexibly and broad behavioral repertoire based on patients’ chosen values and life goals (Hayes et al., 2006; Hayes, Strosahl et al., 1999). In therapy, this is promoted by allowing patients to clarify personal held values concerning, for example, health, love, work, and personal achievement, and by encouraging them to pursue valued goals despite negative internal reactions. Thus, a key assumption is that individuals can pursue life directions and make significant behavioral changes irrespectively of whether thoughts, feelings and physical sensations change. It is further suggested that relating to one’s thoughts and feelings by distancing oneself from such experiences and not taking them literally, will decrease their impact on behavior. This is often promoted in therapy through the means of mindfulness practice or exercises that focus on the ability to mindfully notice thinking as it occurs (i.e., de-fusion). Thus, in essence, ACT seeks to reduce efforts to control or diminish internal experiences through acceptance and mindfulness processes and to increase an individual’s ability to respond more flexibly in the presence of distressing internal events through values and behavior change processes. In the following sections, I will proceed with a more detailed theoretical account of these processes.
ACT for Chronic Pain

The historical “waves” of behavioral and cognitive therapies mirror the treatment development of cognitive-behavioral approaches to chronic pain (McCracken, 2005). In fact, ACT has received considerable amount of attention within the scientific literature on chronic health conditions in general (see, McCracken, 2010, for a book length review), and on chronic pain in particular (Vowles & Thompson, 2010). Treatments targeting acceptance processes have shown promising results for diabetes (Gregg, Callaghan, Hayes, & Glenn-Lawson, 2007), epilepsy (Lundgren, Dahl, Melin, & Kies, 2006), and cardiac problems (Goodwin, Forman, Herbert, Butryn, & Ledley, 2012); and ACT is now considered an empirically supported treatment for chronic pain (Veehof, Oskam, Schreurs, & Bohlmeijer, 2011; Wetherell et al., 2011).

An extensive body of empirical work has been carried out on acceptance-related processes and pain over the last 10 to 15 years. For example, McCracken and colleagues have in a series of studies shown that acceptance of and willingness to experience pain is associated with less depression, better physical and psychosocial disability, better work status, lower pain intensity, pain-related anxiety and avoidance (McCracken, 1998; McCracken, Carson, Eccleston, & Keefe, 2004; McCracken, Vowles, & Eccleston, 2004; Vowles, McCracken, McLeod, & Eccleston, 2008). There are also a number of analog component studies that have provided support to the beneficial effects of acceptance on acute pain experiences as compared with other coping strategies, such as suppression (e.g., Keogh, Bond, Hanmer, & Tilston, 2005; Masedo & Esteve, 2007; see also Levin et al., 2012, for a review). Moreover, treatment studies have shown positive outcomes, even in direct comparative trials with traditional CBT (Wetherell et al., 2011) and pharmacology regimes within a multidisciplinary treatment (Wicksell, Melin, Lekander, & Olsson, 2009). Furthermore, mediation studies have provided support to the theorized processes of change (e.g., Wicksell, Olsson, & Hayes, 2011; see also Vowles & Thompson, 2010).

Given similarities with chronic pain and severe tinnitus and considering the evolution of CBT for tinnitus, it would not come as a surprise if these newer forms of behavioral or cognitive therapies also had been empirically tested for tinnitus. Yet, this has not been the case. If one disregards our own research in the area, there is a paucity of research on acceptance- and mindfulness-related processes in tinnitus. There are few exceptions though. Most noteworthy, are two recent studies (Philippot, Nef, Clauw, Romrée, & Segal, 2011; Sadlier, Stephens, & Kennedy, 2007) that have provided evidence to beneficial effects of mindfulness-based treatments for disability and severity associated with
tinnitus. Despite these initial positive observations, it seems fair to conclude that so far this new avenue has not been extensively explored in tinnitus. In the following sections, I will review the one dimension that has been key focus in this thesis project, experiential avoidance—experiential openness/acceptance, and how the dimension can form the theoretical base for treatment development in CBT for tinnitus.

Experiential Avoidance as a Key Dimension in Psychopathology

There are occasions where avoidance strategies serve their purpose. Obviously, when we are faced with an external threat, our life may depend on them. Yet, there also occasions where attempts of avoidance not only can be fruitless and ineffective, but also be associated with costs. Indeed, although not a profoundly new idea, there is an (re-)emerging notion within the clinical field that any efforts aimed at avoiding or reducing internal events (e.g., thoughts, feelings, or physical sensations) can have detrimental effects on health and functioning (e.g., Hayes, Villatte et al., 2011; Roemer & Orsillo, 2002). Most significantly, is that suppression strategies can produce ironic pernicious effects, exacerbating they very sensation one was trying to avoid. Wegner and colleagues demonstrated these paradoxical effects in an intriguing series of experiments in the late 1980s and the early 90s (see, Wegner, 1994, for an early review). There is now a huge body of work that suggests that suppression is associated with dysregulatory consequences when applied to emotions or thoughts (Wegner, 2009). That is, attempts to remove a “forbidden” disturbing or uncomfortable sensation from mind, may ultimately produce an even greater preoccupation with it, in particular under mental or emotional load. This, in turn, may also create other behavioral problems. Indeed, suppression has been found to be associated with various psychopathology and has been suggested to contribute to the development of or the exacerbation of health problems (Werner & Gross, 2010). There is also growing data to suggest suppression will produce similar effects in the domain of physical sensations (e.g., Burns, 2006; Cioffi & Holloway, 1993).

Drawing on the experimental work of suppression, and the scientific literature on coping, psychotherapy process research and on clinical syndromes, Hayes and colleagues (Hayes, Wilson, Gifford, Follette, & Strosahl, 1996) introduced the concept of experiential avoidance to refer to the pathological process involved in most forms of psychopathology. In essence, experiential avoidance occurs when a person is unwilling to remain in contact with private experiences (e.g., feelings, thoughts, and physiological sensations), and attempts to alter the form, frequency, or intensity of these sensations. It is,
hence, a generic term that covers all forms of internal experiences and refers to any avoidance or escape behavior that functions to alter or change private experiences.

Using the behavioral analytic framework of Relational Frame Theory (RFT; Hayes, Barnes-Holmes, & Roche, 2001), the founders of the concept directed attention to the processes underlying experiential avoidance (Hayes et al., 1996). It is argued that avoidance of pain is built in to the functions of language. According to RFT, this process is based on particular form of avoidance learning that is unique to humans: Whereas non-verbal organisms show avoidance learning in relation to aversive stimuli only, verbal organisms also show avoidance learning in relation to the reactions that follow the presentation of aversive stimuli (Hayes, Levin et al., 2011). In brief, humans treat aversive internal events in the same way they do external, due to the problem-solving and evaluative functions of cognition. It is postulated that this is the very root of the problem.

Based on extensive research on rule-governed behavior, RFT argue that language learning is bidirectional in nature. Although this makes learning enormously flexible, it also has a downside. For example, an individual who experience a negative emotional response to a particular external stimulus, and associate a particular thought with that experience, will develop a negative emotional response to the thought and will experience the thought in the presence of both the emotional response and the external stimulus in the future. Thus, responses in themselves, not just the external stimulus, will become cues prompting avoidance. Through repeated bidirectional learning, other internal sensations that go along with the thought and emotional response may come to signal threat. Based on modern conditioning research, similar points have been expressed in terms of interoceptive conditioning in panic disorder: Physiological responses in themselves become fear-inducing cues that result in avoidance or escape behavior maintained through negative reinforcement (Bouton, Mineka, & Barlow, 2001).

According to RFT, when emotions are evaluated as negative events, people tend to create verbal escape or avoidance rules in order to keep these sensations under control (referred to as fusion). Yet, it is argued that this “solution” will backfire, due to that the rules often contain stimuli related to the experiences that are supposed to be altered (Hayes et al., 1996). For example, deliberate attempts of trying to get rid of a particular thought involves following a verbal rule that contains the same thought. Thus, examining the success or failure in following the rule constitutes contact with the to-be-avoided sensation, thus, making it more likely to appear. Indeed, Wegner (1994, 2009) has pointed to similar aspects in his ironic process theory.
RFT suggests that these rule-governed behaviors—behavior that is initiated and maintained by verbal specification of contingencies as opposed direct contact with contingencies—are less sensitive to environmental contingencies and thus are difficult to alter once established and preserve despite being ineffective or counterproductive. Negative reinforcement of the avoidance behavior itself will maintain the behavior. This can explain why people engage in these costly strategies even if these strategies are harmful and prevent them from using more adaptive or values-based responses.

As noted by Hayes and colleagues (Hayes, Levin et al., 2011), the concept of experiential avoidance overlap with other key concepts in the larger scientific literature (e.g., suppression of thought or emotion, intolerance of uncertainty) and the general idea is supported to a large extent here. However, there also several research groups that have embraced the terminology and have conducted studies on experiential avoidance per se (see, Chawla & Ostafin, 2007, for a review). Taken together, the data seem to support the idea in general.

Acceptance as a Way to Counteract the Effects of Experiential Avoidance

Is has been postulated that the opposite of experiential avoidance is psychological acceptance (Hayes et al., 1996). Indeed, it is argued that acceptance-based therapies directly target experiential avoidance (Hayes, Villatte et al., 2011; Roemer & Orsillo, 2002). Those who defend this notion, have, accordingly, often defined acceptance as experiential openness: “adoption of an intentionally open, receptive, and flexible posture with respect to moment-to-moment experience” (Hayes, Levin et al., 2011, p. xx, advanced online publication). However, acceptance has been used in various contexts, and, only within clinical psychology, acceptance can be defined in a number of ways depending on the theoretical orientation. Here, I consider the concept from a contextual behavioral perspective, as this services my own interest. Although the definitions have varied somewhat even within this perspective—indeed, the very same authors have used slightly different definitions in different papers—researchers seem to emphasize similar aspects.

As the process of experiential avoidance can be described in terms of two related parts—a) unwillingness to remain in contact with privat experiences, and b) action taken to alter these sensations—acceptance is often characterized as a two-fold process. Acceptance involves first a willingness to experience internal sensations. This stance toward inner experiences, in turn, is presumed to change the function of the privat event, which enables the in-
Individual to act flexibly in the presence of the experience. It is often stressed that acceptance is distinct from toleration and resignation, though they may belong to the same continuum (Hayes, 1994). In line with this, acceptance is not promoted in therapy as an end in itself; but rather as means to increase values-based action (Hayes et al., 2006). Indeed, ACT is a modern behavior therapy and the ultimate goal is to change behavior, and, as such, acceptance offers a way to undermine an inactive or avoidant behavioral pattern. In an attempt to clarify the behavioral principles involved in acceptance, Cordova (2001) defined it as the opposite of aversion:

“The stimulus that comes to be accepted is no longer avoided, escaped, or destroyed. Instead, acceptance might be operationally defined as a change in the behavior evoked by a stimulus from that functioning to avoid, escape, or destroy to behavior functioning to maintain or pursue contact.” (p. 215).

However, she continued later in the same article, by stating the following:

“Acceptance also appears to involve changes in the person's reported experience of the stimulus situations from noxious to substantially less noxious or even attractive. [...] What has changed? One argument is that the individual's behavior changes because the stimulus functions of the previously aversive situations have changed.” (pp. 216-217).

Thus, acceptance seems to involve both a change in approach behavior in the context of previously avoided material and a shift in the function of the stimulus situation. This latter aspect of acceptance is related to the concept of defusion (Masuda, Hayes, Sackett, & Twohig, 2004). Indeed, it has been argued that the highest form of acceptance involves a transformation of stimulus functions through the process of defusion (Hayes, 1994). It is postulated that defusion alters the literal or functional context in which cognitions (i.e., thoughts) occur, thereby reducing their impact (Masuda et al., 2004). In other words, defusion breaks verbal processes that underlie experiential avoidance. Thus, without necessarily changing its form or frequency, a particular stimulus (e.g., a thought) acquires a new function(s). The end result of defusion is a decreased believability in thoughts and increased ability to separate self from the immediate experience of physical sensations, thoughts, and feelings that are occurring in the moment, as opposed to being literally one with these experiences. Similar ideas, using a different terminology, have been expressed from other theoretical perspectives in relation to the processes underlying mindfulness (e.g., Williams, 2010).
It is clear that acceptance involves several inter-related processes—I have already mentioned a couple (i.e., defusion, approach or values-based behavior change). Most significantly, however, the concept overlaps with mindfulness, which more recently has been operationally defined: “a process of regulating attention in order to bring a quality of non-elaborative awareness to current experience and a quality of relating to one’s experience within an orientation of curiosity, experiential openness, and acceptance.” (Bishop et al., 2004, p. 234). Despite the definition above, mindfulness seems to be difficult to define for scientific purposes, which may at least in part be due to spiritual and religious foundations of the concept. For example, Hayes and Shenk (2004) argued that Bishop et al.’s definition, although broad and inclusive, might still miss important aspects of the phenomenon, such as nonevaluative, observing and contextual aspects etc. They further argued that given the complexity of the concept, it might with time become less important to define mindfulness per se, but rather in detail explore the processes that underlie the construct. Indeed, several of the terms used to describe acceptance are also found in definitions of mindfulness, making the two concepts indistinguishable scientifically.

As noted earlier, acceptance in ACT and other acceptance-based therapies is often promoted as a way to counteract experiential avoidance. In recent years, even among more traditional behavioral and cognitive therapies similar ideas have been expressed (e.g., Arch & Craske, 2008). In addition, other schools of thought in non-applied areas have embraced the notion. Most significantly, Wegner (2011) have pointed to this fact by stating that any strategy that promote acceptance or reduce the tendency to avoid distressing thoughts may counteract the detrimental effects of thought suppression.

Can Severe Tinnitus be Conceptualized as an Experiential Avoidance Disorder?

Arguable, the most intriguing aspect of tinnitus is that the phenomenon only seems to affect a minority of individuals to a significant degree. This fact, coupled with that psychoacoustic aspects of the sensation cannot explain degree of impact, point to that key psychological processes are involved in the generation and maintenance of tinnitus severity (Hallam, 1986). In the following sections, I will synthesize relevant existing research and theory of tinnitus with the theoretical framework outlined above. First, the utility and implications of experiential avoidance as a key dimension in tinnitus are examined. Next, the role of acceptance in tinnitus is highlighted.
**Emotional conditioning.** Sounds carry meaning. They can provide essential information relevant to our survival and adaption by guiding our attention to key aspects in the environment. Tinnitus can be thought of as an inappropriate response in the particular context where it occurs. Heller and Bergman’s (1953) intriguing experiment provides support to the notion that tinnitus is contextually situated, by showing that almost all people experience tinnitus-like sounds when placed in a soundproof room. In fact, by definition, tinnitus is a contextual inappropriate auditory sensation. Thus, from a strict evolutionarily point of view, the sensation ought to be ignored over time, as it provides no relevant information to the organism (e.g., a threat cue). In other words, it should be functionally “meaningless”. Indeed, as noted earlier, Hallam et al. (1986) emphasized that the normal development is characterized by habituation, and that dishabituation is likely to occur when tinnitus acquires emotional significance through a learning process.

There is now a huge body of work that signifies the emotional aspects of the phenomenon, a fact that more recently also has been corroborated with neurophysiological data and theory (De Ridder, Elgoyhen, Romo, & Langguth, 2011). In particular, severe tinnitus is intertwined with significant emotional distress. However, the mechanisms by which tinnitus causes emotional disturbances and vice versa remains speculative. Like many emotional problems, classical conditioning is most likely involved in the process. Indeed, this has been emphasized as the integral aspect in one of the most influential theories in the field, the neurophysiological model (Jastreboff & Hazell, 1993). However, this notion in the theory has been criticized on a number of grounds (McKenna, 2004), and perhaps rightly so, as the model draws from an old view on conditioning. Yet, as argued in other areas (e.g., anxiety disorders), some of the criticisms can potentially be met when you consider a contemporary view of conditioning and associative learning (Mineka & Oehlberg, 2008).

RFT represents such a modern view. The bidirectional qualities in language learning have been contrasted with the unidirectional nature of operant and classic conditioning. That is, given our verbal ability, we can form associations, and transport stimulus functions, between stimuli indirectly through verbal relations in complex ways (without direct contact). It follows from classic conditioning, that if a negative emotional experience has been associated with an event (e.g., tinnitus)—either directly through contact or indirectly through verbal relations—it is likely that the event will provoke negative emotions alone by mere association. Once the association is learned, a larger network of associations of internal or verbal stimuli may become activated depending on the particular learning history of the individual. Most significantly, evaluative connotation of the event may alter the function of the
experience. For example, the word “tinnitus” may no longer be described based on its sensory qualities, but as a “terrible” noise. The word “terrible” may in turn activate a wide variety of sensations and experiences, including thoughts, memories, and evaluations, among others. Moreover, negativity of the “initial” event may increase even further by relating other verbal events in complex ways. So, if “tinnitus” is related to “terrible” and that in turn is related to “go crazy”, the aversive aspect of “tinnitus” could increase substantially because it is now verbally indirectly related to “go crazy”. RFT provides a modern behavioral analytic account for why that may happen, i.e., transfo-

mation of stimulus functions through arbitrary applicable verbal relational framing. For example, studies show that if an individual who has been aroused by a stimulus paired with a chock, will become more aroused when presented with a neutral novel stimulus that is only related to the original stimulus by a verbal “larger than” cue (Dougher, Hamilton, Fink, & Harrington, 2007).

Regardless, however, of the operant and respondent principles that underlie the phenomenon, the stimulus (i.e., tinnitus) in itself and other associated internal reactions come to take on threatening meanings. Indeed, severe tinnitus is often characterized by catastrophic interpretations of the sound, and catastrophic thoughts about tinnitus have been postulated to play a key role in tinnitus-related fear, vigilance and avoidance (Cima, Crombez, & Vlaeyen, 2011; Weise, Hesser et al., 2012). In addition, a relatively recent event-related potential study found that individuals who were distressed by tinnitus (i.e., tinnitus-complainers) showed a less distinct habituation to external neutral sounds compared to individuals who were less distressed by tinnitus (i.e., non-complainers; Walpurger, Hebing-Lennartz, Denecke, & Pietrowsky, 2003). Moreover, emerging data provide support to that there are distinct neural circuits underlying how tinnitus is processed in the brain in individuals who are distressed by the condition as compared with those who are not (De Ridder, Vanneste, & Congedo, 2011).

Ineffective avoidance. It is argued that once internal events are evaluated negatively, they will prompt avoidance and/or escape behavior, much similar as to any other aversive external event. Yet, as noted earlier, these attempts are bound to fail, and most likely lead to paradoxical effects. Theoretically, individuals who evaluate their tinnitus negatively are likely to use various avoidance strategies in an attempt to cope with tinnitus and other unwanted internal associated sensations. Avoidance in tinnitus is complex as it most certainly can take on many forms. Persons may avoid noisy or silent environments; avoid activities that demand high level of concentration; avoid social activities; avoid using things in the ears; use protective ear gears; or use environmental sounds to mask tinnitus (Kleinstäuber et al., 2012). Attempts
of avoidance may also be directed towards interoceptive experiences, leading
to effortful attempts of suppressing tinnitus thoughts, feelings or other internal
physiological sensations that go along with the experience of tinnitus.

Thus, topographically avoidance behavior may vary considerable among in-
dividuals with tinnitus. Yet, they may be functionally similar; that is,
individuals who seek ways to escape the experience may occasionally receive
a short-term relief. Ironically, the very same behavior may produce an even
greater preoccupation with the sensation and the stimulus itself may take on
more threatening meanings, and thus, prompting more attempts of avoidance.
In this way, individuals are trapped in a cycle of experiential avoidance, per-
petuating negative reactions to tinnitus through their attempts to end the
experience. Over time, this may lead to severe behavioral restrictions.

For example, an individual may use background sound to mask the expe-
rience, perhaps fused with a particular thought, “irritating noise”. The person
will most likely receive a short-term relief from the sensation, coupled with
decreased automatic responses, following the behavior. This diminished au-
tomatic activation is likely to be negatively reinforcing, thereby increasing the
frequency of such coping attempts in the future. In fact, some individuals may
even experience that tinnitus temporary disappears following masking (i.e.,
residual inhibition), which is likely to fuel the notion that tinnitus can be con-
trolled. However, since environmental sounds vary over time and context,
tinnitus will reappear—perhaps now with even more strength considering the
changing-state hypothesis and the effects of masking—together with i-
creased automatic responses and more frequent thoughts about “irritating
noise”. Moreover, the behavioral restricts can be detrimental. In order to co-
trol tinnitus, the individual now constantly must use background sounds to be
able to function.

Research on coping strategies supports the notion of negative effects of
avoidance in tinnitus. Budd and Pugh (1996a) identified a “maladaptive”,
“passive” and “effective” coping style pattern among patients with tinnitus (N
= 116). Both the “maladaptive” and the “passive” style of coping clearly in-
volved active attempts of avoidance, such as daydreaming of life without
tinnitus, avoiding social situations, excessive use of sounds to mask tinnitus,
or consulting professionals about tinnitus. High scores on the scales were
found to be associated with increased tinnitus severity and emotional distress.
In a replication of this work, the same authors (Budd & Pugh, 1996b) using
the same coping items, identified a two-factor solution: Maladaptive coping
and effective coping. Once again, the maladaptive coping scale, as opposed to
the effective coping scale, was significantly and strongly associated with both
tinnitus severity and depression and anxiety (r range .62-.70). Similarly,
Hallberg, Erlandsson, and Carlsson (1992) found that men with severe tinnitus more often engaged in “escape coping”—e.g., taking drugs or alcohol to feel better, wishful thinking—than those who had less severe tinnitus. A more recent study, conducted over the internet, have extended these findings by showing that more frequent attempts of coping, regardless of type of coping, was associated with increased tinnitus severity (Andersson, Kaldo, Strömgren, & Ström, 2004).

In more recent years, tinnitus-related avoidance has been examined within broader theoretical frameworks of tinnitus distress and disability, including the fear-avoidance model adapted to tinnitus (Cima et al., 2011; Kleinstäuber et al., 2012), and the anxiety sensitivity model of chronic health conditions (Hesser & Andersson, 2009). In all situations, avoidance has been found to be associated with increased negative emotional and tinnitus-related distress and/or decreased functioning. For example, Hesser and Andersson (2009), using data from a national population study of tinnitus, found that avoidance due to tinnitus mediated the association between anxiety sensitivity (i.e., fear of anxiety symptoms) and tinnitus-related functioning and distress. Another recent study using a large clinical sample of individuals with tinnitus found strong correlations between a tinnitus-specific avoidance measure (adapted from the fear avoidance model of chronic pain) and tinnitus severity (Kleinstäuber et al., 2012).

To sum, severe tinnitus can be characterized by excessive use of ineffective avoidance strategies prompted by negative evaluations of the sound and an unwillingness to experience tinnitus and other unwanted associated internal sensations. As such, experiential avoidance may play a key role in tinnitus.

How may Acceptance Counteract Experiential Avoidance in Tinnitus?

Assuming that severe tinnitus is characterized by experiential avoidance as theorized in the previous section, approaches that emphasize experiential openness or nonavoidance are likely to reverse the cycle that maintains tinnitus-related problems. Theoretically, they may do so in a number of different ways.

Acceptance reduces ineffective strategies. From the research reviewed above, it seems clear that tinnitus-related avoidance coping is associated with increased severity. Acceptance offers an alternative approach that may reduce the detrimental effects of these avoidance strategies (Wegner,
Indeed, sensory monitoring—to attend in neutral way to internal sensations (Ahles, Blanchard, & Leventhal, 1983)—has been suggested to facilitate adaptive responses by eliminating ineffective strategies (suppression/diversion). In a review of the effects of different attentional strategies on somatic interpretation, Cioffi, (1991) argued that noxious physical sensations cannot be ignored for long and attempts to distract will ultimately fail. Under these circumstances, monitoring as a “confrontational” strategy in the experience of negative sensations may work far better. It was further argued that sensory monitoring provides information about the physiological status that may facilitate more appropriate self-regulatory behaviors as well as adaptive emotional regulation (Cioffi, 1991). That is, through focused attention, one has the opportunity to notice shifts in internal sensations (e.g., a ebbing of discomfort) and also learn how to discriminate painful stimuli with those that are merely associated with such sensations.

Acceptance changes the stimulus functions. Acceptance processes (e.g., defusion, mindfulness) can diminish the verbal rules thought to underlie experiential avoidance by relying on present-moment contingencies rather than verbal contingencies. By mindfully attending to tinnitus and associated internal sensations, individuals may disentangle the evaluations and thoughts about their tinnitus from the auditory sensation itself. Indeed, similar ideas have been expressed with regards to sensory monitoring and somatic sensation more broadly (Cioffi, 1993). Focusing on a stimulus using concrete sensory awareness has been suggested to detach it from its presumably default negative emotional tone (Cioffi, 1991, 1993).

This will ultimately also change the function of the particular stimulus (i.e., tinnitus) as the negative labels may carry implications for avoidance behavior. Focusing on present-moment-to-moment experiences, is argued to reduce the tendency to create verbal avoidance or escape rules that are ultimately deemed to be ineffective or even counterproductive (e.g., “I must get rid of tinnitus before I can function”; c.f., Hayes, Levin et al., 2011). More precisely, this allows for direct contact with environmental contingencies, making it possible to identify strategies that are ineffective and instead rely on responses that are contextually more adaptive. In another words, acceptance may facilitate a context in which more effective and appropriate responses can be made by changing the relationship with the experience. The initial observation that mindfulness-based treatments that explicitly target such processes can reduce disability due tinnitus may provide some support to these claims (Philippot et al., 2011; Sadlier et al., 2007).

Acceptance facilitates new learning or habituation. Escape or avoidance behavior can maintain threatening meanings and negative emotional
responses associated with the experience of tinnitus; that is, avoidance of fear-related conditioned stimuli maintains fearful associations by precluding new learning (Craske et al., 2008). Engaging in behaviors that function to pursue and maintain contact with tinnitus, rather than in ones that function to destroy, escape or eliminate it, may facilitate habituation or new learning in relation to fearful responses associated with the sensation. Staying in contact with the experience and associated negative emotional responses, can foster an increased ability to function in the presence of the experience. Thus, exposure to these sensations may lead to more optimal functioning, either through diminished emotional responses or increased inhibitory learning (Craske et al., 2008). As the fear-eliciting stimuli involved in tinnitus are mostly internally generated (i.e., difficult to identify any specific external event that may trigger the onset of distress) and as tinnitus is not characterized by a specific behavioral pattern of avoidance that can be targeted directly (c.f., specific phobia), acceptance strategies can promote beneficial effects of exposure indirectly through values-based actions and mindfulness practice (c.f., Roemer & Orsillo, 2002).

Acceptance facilitates a flexible behavioral repertoire. Tinnitus can be troubling for anyone afflicted, and sometimes behaviors that are valued (e.g., going to a concert, social activities) are intertwined with difficult and painful experiences. Basically, in certain situations there is no way around psychological distress. As noted earlier, acceptance is promoted in treatment as a way to increase values-based responses. Thus, acceptance is presented as an active choice in any give situation and often contrasted against alternative behaviors, such as avoidance or control strategies. Individuals are encouraged to pursue goals linked to their own values despite negative feelings or reactions. A significant amount of time is thereby devoted to clarifying values in ACT. It is argued that such values work promotes behaviors that ultimately are appetitive rather than avoidant. Indeed, in ACT, values are defined as verbally constructed appetitive life consequences of behavioral patterns, for which the reinforcer becomes intrinsic (Hayes, Levin et al. 2011). Thus, it is assumed that it directly targets avoidance and provides a flexible behavioral repertoire in the presence of aversive stimuli.

Moreover, approach behavior within a values context may very well change the stimulus function of the negative experience itself. Indeed, it might be of critical importance to differentiate between a willful and unwilling awareness of difficult sensations. Some indirect support for this idea is found in the experimental literature on conditioning, showing that perceived control of aversive stimuli—genuine control of the stimuli is not necessary; rather the individual need only to believe that she/he has control—is associated with a less distinct conditioning effect in laboratory settings (Mineka & Oehlberg,
2008). Initial work also provides encouraging findings in support to brief values interventions in task persistence in the context of experimentally induced pain (e.g., Páez-Blarrina et al., 2008). In addition, promoting behaviors that ultimately will allow for increased contact with competing external cues, will most likely result in decreased focus on tinnitus. Indeed, Pennebaker (1982) proposed in a theory of how we become aware of physical symptoms, that the probability of noticing internal states is a direct function of the ratio of the quantity or salience of internal to external information.

To sum, acceptance processes may facilitate emotional processing, flexible ways of responding, and new learning that will challenge fearful reactions and interpretations of tinnitus. In addition, acceptance may be the only viable means to achieve appetitive behavior change in situations in which tinnitus-related distress is unavoidable. It is however important to remember that these mechanisms underlying acceptance are at present time only speculative.

**Empirical Support to Acceptance in Tinnitus**

Only a few studies have explicitly examined acceptance-related processes in tinnitus so far. However, given that avoidance behaviors have been found to be associated with severity of tinnitus, any attempt to reduce such coping attempts are likely to affect the experience of tinnitus. In addition, there is now emerging data to support activity engagement, i.e., the ability to pursue valued activities despite of tinnitus, as a key construct in tinnitus (Weise, Kleinstäuber, Hesser, Zetterqvist Westin, & Andersson, 2012; Westin, Hayes, & Andersson, 2008). For example, Westin, Hayes, and Andersson (2008) found that activity engagement mediated the associations between tinnitus-related distress and various psychological variables, including quality of life, depression and anxiety, measured at two occasions (at intake and 7 month follow-up).

A few studies that have used more direct measurements of acceptance (e.g., “I simply let my tinnitus noise be there in the background” or “I continue with my daily life as if the tinnitus is not there”) have also found support to the beneficial consequences of the construct (Andersson, Kaldo et al., 2004; Davis & Morgan, 2008; Schutte, Noble, Malouff, & Bhullar, 2009). For example, Davis and Morgan (2008) included questions such as “Have you accepted that your tinnitus will never be cured?”, and “Do you think about or imagine what life without tinnitus would be like?” to examine acceptance of tinnitus. The results of that study indicated that individuals who had greater acceptance reported lower depression scores, greater well-being, fewer visits
to physicians and health care providers for tinnitus-related issues, and decreased fears that their tinnitus would get worse. Furthermore, a recent experimental study that compared acceptance and suppression strategy rational for the ability to sustain in a mental imagery task with a no rational instruction (control condition), found that participants who were given an acceptance rational could sustain in the task for a longer time than those in the control condition (Westin, Östergren, & Andersson, 2008). As noted earlier, mindfulness practice also seems to be associated with beneficial consequences. These results, taken together, give initial support to acceptance as a key construct in tinnitus, and hence a construct worthy of further study.

Scientific Strategy and Philosophy of Science

Any scientific journey starts with a single step. Moving is most likely not the problem; rather direction: how do we know that we are moving in the right direct? To articulate the scientific approach to theory and the particular goals of the science is an essential part of the journey. For example, how can we verify the validity of any scientific construct that we use, if we do not know what constitutes a “valid” construct to begin with? In the following section, I will do just that; that is, I will articulate my scientific strategy.

Broadly, I adhere to the scientific and philosophical framework outlined by Hayes and colleagues (Hayes, Levin et al, 2011; Vilardaga et al., 2009), embraced as a broad approach to scientific progression, and recently named Contextual Behavioral Science (CBS). CBS is defined as:

“a principle-focused, inductive strategy of psychological system building, which emphasizes developing interventions based on theoretical models tightly linked to basic principles that are themselves constantly upgraded and evaluated. It involves the integration and simultaneous development of multiple levels of a research program including philosophical assumptions, basic science, basic and applied theory, intervention development, and treatment testing.” (Hayes, Levin et al., 2011 p. xx, advanced online publication).

The approach is rooted with the behavior analytic tradition and rests on a pragmatic philosophy of science, known as functional contextualism. I will start by clarifying the philosophy of science and then briefly describe the scientific strategy in terms of its methodology. It is beyond the scope of this
introduction to present functional contextualism as a philosophy of science and CBS as a broad scientific approach in detail. A comprehensive and detailed account of functional contextualism and CBS can be found elsewhere (Hayes, Hayes, & Reese, 1988; Vilardaga et al., 2009).

**Philosophical Assumptions**

Functional contextualism is an extension of radical behaviorism as defined by B. F. Skinner (Hayes et al., 1988). The core concept within this philosophy of science is *Act-in-context*; a concept that dictates that all actions are considered whole events that have no meaning or purpose without reference to the contexts in which they occur. The approach is related to a pragmatic tradition within philosophy, in that it rests on a pragmatic truth criterion: “Successful working”. “Truth” is examined in relation to successful working towards one's analytic goals and an analysis is said to be true or valid to the extent it leads to those goals (Hayes et al., 1988). It is however important to note that the analytic goals of the science are not true in themselves; rather, they are declared a priori and owned by the researcher. This can be viewed as a a-ontological stance (Barnes-Holmes, 2000): One is not interested in making ontological claims about what is “real” and not in the world. Indeed, it is argued that all predefined analytic goals, as any other ontological claim, dissolves within this pragmatic epistemology, as the claim itself is always an act-in-context (Hayes et al., 1988). Thus, epistemology is emphasized over ontology, and epistemology is always defined pragmatically. As such, “true” laws of the universe, i.e., causality, are not said to be in the world itself (c.f., realist position: truth-corresponding criterion); rather, these are analytic concepts we use to talk about the world. For example, causality, from a functional contextualistic perceptive, is an analytic term we use to describe how “we behave effectively, in give context for given purposes” (Hayes, Levin et al., 2011, p. xx, advanced online publication). One may question if this stance precludes scientific generalizability, and in one sense, it actually does: Any event is unique as it is contextually situated (Biglan & Hayes, 1996). Yet, although generalizability is not inherent in the world, one analysis may be applicable to more than one event; that is, it may be possible to use the same analytic concepts to describe several different events—not because these events are the same, but because the same analysis works for them (Biglan & Hayes, 1996). Yet, we must remember, that “workability” is always determined in relation to the predefined goals of the researcher and these goals are not argued but declared a priori.

The predefined analytic goals of CBS is: “the prediction and influence of psychological events (i.e., the behavior of whole organisms interacting in and
with a context defined historically and situationally) with precision, scope, and depth” (Vilardaga et al., 2009, p. 110). It is important to note that researchers from the perspective seek both prediction and influence of the events. This is not two goals, but one overarching scientific goal. Thus, it requires the researcher to specify manipulable events and any model is judged to be insufficient if it cannot met the goal of “influence”. This is also why the approach stresses context, since only contextual variables can be manipulated directly. Precision, scope and depth refer to the extent a particular analysis coheres with other analyses at other levels (i.e., depth: e.g., a psychological and biological level), is applicable across a wide range of phenomena (i.e., scope), and is specific enough in how it applies to a given phenomenon (i.e., precision). Accordingly, the overarching goal of science is to be applicable in terms of precision, scope, and depth, and the proof of a theory is in its contribution to prediction and influence (Biglan & Hayes, 1996). At the core of this philosophy is utility and the validity of any scientific claim is examined in relation to this overriding goal—similar ideas, but from a different perspective, has been expressed in an interesting review article of the concept of validity in psychology (Borsboom, Mellenbergh, & van Heerden, 2004). Rather than verifying “truth” of an analysis by, for example, using logic or reasoning, a pragmatic stance assumes that truth of a given analysis is always found in its utility. It follows from this, that an analysis can be true in one context but not in another—an old classic assumption within behavior analysis (Strosahl & Linehan, 1987).

**Overall Strategy: Examining Processes and Principles tied to Theory**

It has been argued that an excessive focus on technology and outcome research can lead to a less progressive science of clinical psychology (Hayes, Levin et al., 2011). That is, knowledge we gain from technology or outcome research is of little value when it comes to treating a new problem/situation or when we need to develop new interventions. A far better approach can be to rely on key functional processes. At the core of the scientific strategy outlined here rests this assumption. The goal is to establish principles and processes that are broadly applicable in various situations and that can be directly linked to technology. The processes must adhere to the overarching predefined goals of the science, that is, they need to be events that at least in principle are sensitive to change (influence) and related to target outcome (prediction).

This overall strategy is not a new one. In the beginning, behavior therapy was primarily concerned with developing procedures tied to specific learning
principles developed in the laboratory (Hayes, 2004a). In recent years, however, a growing interest for developing empirically validated processes, rather than focusing on empirically supported treatments (EST movement), has surfaced in the field of clinical psychology at large (e.g., Barlow, Allen, & Choate, 2004; Kazdin, 2007, 2008). From the perspective of the clinician, one can understand why: Clinicians can apply interventions based on empirically validated processes in a flexible manner, instead of using rigid treatment protocols for disorders, consisting of various procedures that may not suit the individual client and his/her particular problem. As such, assessment can be directly linked to interventions deployed—a core assumption in the behavior analytic tradition (Strosahl & Linehan, 1987).

From a strict scientific point of view, this strategy may also bear fruit. Such a shift in research focus from “outcomes only” to pragmatically useful processes is stipulated to produce a greater flexibility within the development strategy itself, and ultimately led to a more progressive science (Hayes, Levin et al. 2011). Rather than focusing solely on developing a new technology, we may need to start by specifying the processes involved in pathology (e.g., tinnitus severity), or human functioning more broadly (depth). This bottom-up, inductive strategy can promote development of innovative procedures/interventions that explicitly aim to target these processes. Rather than testing treatment protocols/components in large randomized controlled trials, i.e., the top-down approach, relying on key processes to guide our treatment development can be more cost-effective and in the long run be a faster way of eliminating ineffective procedures and enhancing effective ones in our treatment protocols (Kazdin, 2008).

This can also facilitate a context in which results from basic science can be integrated into applied science to a greater extent than previous. Indeed, they very idea is built on having basic science as the foundation of the scientific development (Vilardaga et al., 2009). A contextual strategy for treatment development, may also allow one to examine and organize procedures/technologies in terms of functional processes. That is, we can classify them in accordance with how they produce change, i.e., whether they share unique qualities or are distinct. Most significantly, this allows us to determine if we have developed a “new” procedure or not (O’Donohue & Yeater, 2003). Rather than classifying our procedures based on labels we use to describe them, we can determine the distinctiveness by examining the mechanisms that causally produce desired consequences (O’Donohue & Yeater, 2003). This can have direct practical implications in terms of treatment evaluation. For example, if two technologies broadly achieve the same outcome at average, but do so through distinct processes of change, this suggests that they may work in different circumstances or for different
individuals (i.e., moderation), and hence are distinct approaches. In contrast, say that two treatments produce different outcomes, but change in outcome is related to the same mechanism across approaches, we can conclude that the underlying model is functionally similar, but their technology may differ, i.e., one of the treatments to better extent target the process of interest. Thus, the strategy allows new techniques to be developed and tested within a coherent framework in which they can directly be contrasted, refined and optimized in relation to target processes.

Methodology: A Multi-Method Approach

Research methodology is the way we systematically collect, organize and interpret data and is directly linked to the theoretical and the philosophical framework we use (Kazdin, 2009). Accordingly, methodology that ultimately provides useful theories in relation to the predefined goals of the science is deemed appropriate. In this context, where the goal is prediction and influence, any methodology that provides a link between key processes of change, technology, and theory is relevant. Obviously, methodology that directly allows one to examine how variables influence behavior is the most effective method. The experimental single-case design is at the core of the behavior analytic tradition, as it allows one to examine a particular behavior by systematically varying the context governing that behavior (Barlow & Hersen, 1973). Although this experimental approach is very much relevant to the overall scientific strategy, it provides no test to the degree to which we can generalize the analytic concepts and processes across a wide variety of contexts (scope). Thus, although the ideographic approach to the study of behavior is present in this contemporary behavior analytic methodology, group-based experimental approaches are emphasized to larger extent than previously done within the tradition (Vilardaga et al., 2009). This is also coupled with an applied interest in inferential statistics. Indeed, the development of advanced statistical analyses of longitudinal observations that incorporate data from the individual as well as the group (Rogosa & Willett, 1985), meshes nicely with the approach. It is however important to remember that rather than assume generalization of results on the basis of random sampling, as done in classic statistical theory, CBS requires that generalization to be explicitly tested (see also, Cook, 2004, for alternatives to random sampling in causal generalization).

Any group-based experimental approach is of value, and of course, the randomized controlled trial, as the golden-standard in scientific practice, can provide useful information regarding how a particular treatment can influence
the probability of behavior (Biglan & Hayes, 1996). Yet, as argued by several (Kazdin, 2007), to rely on the controlled trial to answer questions about mechanisms of change might not be optimal or even possible; rather, experimental studies that isolate specific techniques or components to determine their efficacy of impacting a predefined outcome (i.e., a relevant behavior or processes of change) are often promoted. This small-analogue approach of analyzing components is often contrasted against a “top-down” approach to treatment development, where treatment packages are broken down and examined in large-scaled dismantling studies. Given the amount of time and cost associated with such research efforts, the former approach is often preferred over the latter.

It is important to note, however, that other methods, besides experimental ones, are also appropriate. In fact, any methodology that contributes to the overriding goal of prediction and influence is legitimate and a diverse set of methods can be employed with this framework. Indeed, CBS is defined as a multi-method approach (Vilardaga et al., 2009). For example, correlation data can provide important clues to how a variable influence behavior, and hence, studies using such methodologies can be readily incorporated within the scientific strategy (Biglan & Hayes, 1996).

Mediation analysis as a statistical approach to explore the relationships between theorized processes of change and outcome in treatment studies is most relevant here (Kazdin, 2007; MacKinnon, 2008). Mediation provides a test as to whether a specific technology changes the target process (the so called a path) and whether the process changes the outcome (the so called b path). When mediation fails it gives us important clues to if this is due to a poor technology (i.e., intervention did not influence processes of change; action theory) or to a poor specified conceptual model (i.e., intervention did change the process, but the change in process did not account for the variability in outcome; conceptual theory; MacKinnon, 2008). Moderation is also of interest, i.e., the influence of a third variable on the impact of treatment on outcome. Analyses of moderation can provide information about in which context or for whom a particular intervention works (Kazdin, 2007), and are, as such, coherent with the CBS approach. For example, a particular treatment might work for those individuals who are low on the particular process it is suppose to target, but not for those high on the process (c.f., Masuda et al., 2007). Indeed, it has been argued that mediation and moderation are key tests of a CBS approach to treatment development as they “simultaneously examine the utility and coherence of the relationship between theory, technology, and outcomes” (Hayes, Levin et al., 2011, p. xx, advanced online publication).
In sum, the scientific approach outlined here is an inductive multi-method approach based on pragmatic philosophy. It emphasizes processes and principles tied to applied theory and the development and the examination of procedures linked to these processes and principles—all in the service of prediction and influence with precision, scope, and depth.
2. EMPIRICAL STUDIES

Overarching Aim

The overriding aim of this thesis project is to improve existent behavioral and cognitive behavioral procedures in the treatment of tinnitus and to enhance our understanding of functional processes that underlie tinnitus severity. This is not two aims, but one, as it is assumed that these are two interrelated goals of a successful scientific strategy for the development and dissemination of treatments in the area. Rather than just concentrating on developing and testing a new CBT-based technology, the scope of the thesis project is broader, focusing on clinical processes across a wide variety of applied contexts and using a broad array of methods. Yet, the aim is still precise; the research aims to examine one dimension in tinnitus: Experiential avoidance—experiential openness/acceptance. The thesis project takes a multi-method approach to the study of the utility of this dimension. The thesis encompasses experimental work (Study II, VI), process and mediation studies (Study I, III, V), and randomized controlled trials (Study III, IV).

Study I. Clients’ In-Session Acceptance and Cognitive Defusion Behaviors in Acceptance-based Treatment of Tinnitus Distress

Aim

The aim of this study was to examine the utility of clients’ in-session observer rated cognitive defusion and acceptance behaviors in predicting long-term outcome following face-to-face ACT for tinnitus. Few studies had at that time examined ACT-related processes with behavioral measures and in detailed explored the temporal relations between processes and outcomes in any ACT trial. The study also represented one of the first studies to examine processes of change in CBT-based treatments for tinnitus.
Methods

In this study, observer ratings of clients’ verbal behaviors were made from video recordings of therapy sessions of ACT for tinnitus and analyzed in relation to primary outcome, Tinnitus Handicap Inventory (THI; Newman, Jacobson, & Spitzer, 1996), a widely used self-report instrument to assess global tinnitus severity. The THI was collected on session-to-session basis. Data for the study were collected as part of the outcome trial examining the efficacy of face-to-face ACT in the treatment of tinnitus severity (Study III). Participants included 19 clients who met criteria for inclusion in the trial. In addition, videotapes of session 2 in the beginning, session 4 in the middle, and session 6 in late part of the treatment, needed to be available for coding. Four raters—two licensed psychologists and two undergraduate students in psychology—who were blind to identity of client, outcome, and session number, rated the middle portion of sessions that were randomly assigned to them.

Ratings were made in accordance with a rating protocol specifically designed for the study, Acceptance and Defusion Process Measure (ADPM; Hesser, 2008). Raters used the video recordings to identify and code verbal behaviors that expressed either defusion (e.g., “I have a thought”) or acceptance (e.g., “I can make room for that”). Once a relevant verbal behavior was identified, a code was assigned along with time. Every acceptance and defusion statement was also assigned an extensiveness value using a 5-point scale, where high values indicating great in-depth acceptance and defusion. Frequency and peak level—the highest extensiveness score given to a behavior during a session—of acceptance and defusion behaviors were analyzed in relation to outcome (i.e., changes between pretreatment and 6 month follow-up). Prior to rating study sessions, raters received training with the ADPM rating protocol. Thirteen randomly selected sessions (23%) of all the rated sessions (n = 57) were used to establish inter-rater reliability in the study. The four raters formed two pairs in the calculation of inter-rater agreement.

Results and Discussion

The combined inter-rater agreement for the two pairs of raters was good, both in terms of inter-category assignment (defusion vs. acceptance) and intra-category extensiveness ratings (1-5 point scale). Analyses of week-to-week changes in THI indicated a rapid improvement over the course of treatment: A statistically significant difference in means between pretreatment and session 3 was detected and a substantial reduction in tinnitus severity was found at 6 months follow-up (within-group Cohen’s $d = 0.91$). As there were no sig-
significant difference in means between pretreatment and session 2, and given that early rapid improvement could contaminate the potential relationship between later rated processes variables and outcome, session 2 rated processes were analyzed in relation to changes in outcome between pretreatment and 6 month follow-up. Both frequency and peak level of defusion were statistically significantly related to changes in outcome ($r = .62$ and $r = .50$, respectively). In addition, peak level, but not frequency, of acceptance was significantly associated with outcome ($r = .51$).

To control for that these associations were not due to prior improvement in tinnitus severity, a series of hierarchical regression analysis was performed. These analyses did not alter the findings; that is, all significant zero-order correlations were also significant in the regression analyses in which session 2 THI score was entered in the model prior to the process variable. Initial tinnitus severity was unrelated to process variables. In addition, we found little evidence for that prior change in THI scores predicted subsequent rated processes variables in session 4 and 6.

Collectively, these results indicate that acceptance and defusion were not mere results of reductions in distress, but played a causal role in the prediction of outcome changes in treatment. Obviously, the study could not control for other third variables and we have no way of empirically testing whether it was the treatment per se that accounted for variation in process variables. Given that the associations were found early in treatment, one might questions if these behaviors actually reflect skills learned in therapy. On the other hand, any variable that is stipulated to play a causal role must change prior to the outcome (Kazdin, 2007). Thus, given the rapid improvement in treatment, process variables needed to account for the outcome very early to be considered as mechanisms. Furthermore, pretreatment severity was not associated with none of the process variables, suggesting that these behaviors were not mere reflections of pretreatment characteristics. Still, these results are all based on an average population change. Individuals may change at different rate both on the purported process and outcome variable and processes analyses need to take into account inter-individual differences in intra-individual change.
Study II. Consequences of Controlling Background Sounds: The Effect of Experiential Avoidance on Tinnitus Interference

Aim

The aim of this study was to indirectly manipulate control efforts by experimentally varying the ability to control background sounds and to examine the immediate and delayed effect of control on perceived interference of tinnitus and cognitive performance. Masking by the use of sounds has been one of the most commonly applied means of dealing with the intrusiveness of tinnitus. Yet, little is known about if and how behavioral control of the masking sound influence tinnitus perception and interference.

Methods

This was an experimental study using mixed design with a short series of repeated trials (2 × 4). Participants with tinnitus (N = 35) were randomly assigned to one of two conditions: Control of background sounds and no control of background sounds. All participants completed a series of Digit-Symbol tests (Wechsler, 1981) while listening to background sounds presented binaurally in a pair of headphones (Telephonics TDH 39P) using an AD 229e diagnostic audiometer. After each trial, participants responded to one questions on degree to which tinnitus interfered with their performance (tinnitus interference), rated on a 5-point scale where a high value indicating high interference. In addition, they answered 4 trial demand questions concerning tinnitus perception (i.e., if they had heard their tinnitus during the trial), and performance (i.e., satisfaction with the performance, background sound interfering with performance, and background sound aiding the performance).

All participants completed the Digit-Symbol subtest before the experimental manipulation as a measure of baseline cognitive functioning and then repeated the same test four times after the manipulation. They had 90 s to complete the test each occasion. Participants in the experimental condition (i.e., control of sound condition) were, before each trial, given the opportunity to choose type of background sound that should be used to mask tinnitus and to adjust the loudness level of the sound. In contrast, participants in the control condition (i.e., no control of sound condition) were not able to choose background sound and were randomly assigned sounds and loudness levels of the sounds (with a fixed starting point of 30 dB HL) before each trial. After completing
the experimental phase, all participants answered self-report instruments on tinnitus severity (THI; Tinnitus Reaction Questionnaire, TRQ; Wilson et al., 1991), anxiety and depression (Hospital Anxiety and Depression Scale, HADS; Zigmond & Snaith, 1983), and insomnia (Insomnia Severity Index, ISI; Bastien, Vallieres, & Morin, 2001). Tinnitus interference and performance on the Digit-symbol test served as the dependent variables in the experiment. To make full use of the repeated trials in the experiment, we employed a latent growth model data analytic strategy to adequately model inter-individual differences in intra-individual change as a function of experimental manipulation (Muthén & Curran, 1997). Linear growth trajectories were estimated with correlated random intercept (centered at first trial) and slope.

**Results and Discussion**

Experimental conditions did not differ significantly on any of the self-report instruments, baseline cognitive functioning, or demographic variables, with the exception for age. Across conditions, there was a significant individual difference in rates of growth and an average linear increase in growth for both tinnitus interference and cognitive performance over experimental trials. More important, individuals in the control of sound condition had a faster rate of growth on tinnitus interference over trials than those in the no control of sound condition (illustrated in Figure 1). Interestingly, individuals in the control of sound condition reported less interference the first trial after manipulation as compared with those in the no control of sounds condition. Moreover, control of background sounds was associated with a slower rate of improvement on the Digit-symbol subtest across trials. These differences could not be attributed solely to trial demand, as loudness levels of background sounds did not differ among the groups, nor did presence of tinnitus and subjective ratings of satisfaction with the performance, background sound interfering with performance, and background sound helping the performance. These findings parallel the results of experimental work on suppression, showing that individuals can in fact suppress thoughts, emotions or physical sensations, but the detrimental effects of suppression show up later, when these events rebound and give rise to cognitive disruptions, increased physiological arousal, or poorly calibrated behavior (Wegner, 2009).

These results are particularly noteworthy given that no instructions were given to participants on how to approach the task; rather, manipulation was carried out without intent or knowledge of the participant. Arguable, the methodology provides a stringent test of how control efforts of masking may
result in a preoccupation with tinnitus. However, it is important to note that individuals in the control of sound condition were not allowed to choose the same sound twice in the experiment. Although this was done to prevent them from habituating to the background sound, it could still have adversely affected their performance and interpretation of tinnitus. Furthermore, a significant difference in age was observed between conditions, which could potentially explain the difference observed on the Digit symbol test. On the other hand, no difference was observed on the test at baseline, suggesting that effects were truly due to manipulation.

Figure 1. Estimated individual linear trajectories of tinnitus interference over trials as function of experimental manipulation. Control = Control of background sound; No control = No control of background sound.

Study III. Acceptance and Commitment Therapy versus Tinnitus Retraining Therapy in the Treatment of Tinnitus: A Randomised Controlled Trial

Aim

The aim of this study was to examine the relative efficacy of face-to-face ACT as compared with Tinnitus Retraining Therapy (TRT) and wait-list control (WLC) in a randomized trial. Another aim was to investigate whether ACT exerts it effects on primary outcome by the means of acceptance of tin-
nitus. This was the first controlled trial of ACT for tinnitus and one of the first studies to examine mechanisms of change in psychological treatments for tinnitus.

Methods

Participants were recruited from three audiology departments and through advertisements. They needed to meet the following criteria to be included in the trial: a) to have tinnitus as their primary problem; (b) to be at least 18 years old; (c) to have a score of 30 or more on the THI; (d) a duration of tinnitus of more than 6 months; (e) not to suffer from a severe psychiatric disorder; (f) not to have previously received a psychological or sound-generator treatment for tinnitus; (g) not be in need of immediate medical consultation; and (h) to have hearing thresholds which would allow for the use of wearable sound generators.

Of 174 assessed for eligibility, 64 were included and randomized to ACT ($n = 22$), TRT ($n = 20$), or WLC ($n = 22$). All participants completed measures of tinnitus severity (THI; primary outcome), insomnia (ISI) depression and anxiety (HADS), and quality of life (Quality of life Inventory, QOLI; Frisch, Cornell, Villanueva, & Retzlaff, 1992) at pretreatment, approximately 10 weeks from start of the treatment (posttreatment for ACT), 6 and 18 months follow-up (posttreatment for TRT). In addition, the Tinnitus Acceptance Questionnaire (TAQ; process measure; Westin, Hayes et al., 2008) was administered to participants in ACT and the WLC at approximately 5-weeks after pretreatment (midtreatment) to allow for examination of mediation.

ACT was delivered in individual format over the course of 10 weeks using a structured treatment protocol, adapted predominately from ACT protocol for anxiety disorders (Eifert & Forsyth, 2005). Sessions ranged between 45 and 75 minutes and focused on acceptance and mindfulness training, but also included behavioral interventions targeting problems commonly associated with tinnitus (hearing, sensitivity to noise, sleep problems). The acceptance training included mindfulness and values exercises aimed at promoting a non-evaluative stance towards tinnitus and associated internal experiences and at encouraging individuals to pursue life goals based on clearly defined values. Therapists ($N = 8$), who were primarily undergraduate students in clinical psychology, received weekly supervision by two licensed psychotherapists with extensive ACT treatment experience. The TRT was based on the treatment principles outlined by Jastreboff and Hazell (2004). Participants allocated to TRT were provided wearable sound generators (WSG’s: Starkey,
GN Resound). At an initial appointment (approximately 2.5 hours), sound generators were fitted and participants were given information about sound therapy and how to wear and use the sound generators. The first appointment also included medical consultation focusing on the neurophysiological model of tinnitus. The treatment lasted for 18 months in total and also included a follow-up session (30 minutes) delivered via phone. An ear-nose-throat physician, who had extensive experience in treating tinnitus patients and had received training in TRT, provided the medical consultation.

Independent clinicians, blinded to group allocation, assessed improvement and/or deterioration in accordance with the Clinical Global Impression-Improvement scale and clinical significance was determined with a reliable change index (RCI; Jacobson & Truax, 1991). Two sets of primary outcome analyses were performed using liner-mixed regression analyses (Verbeke & Molenberghs, 2000) with the full-intention-to-treat sample. As latent growth modeling, these analyses allow individual specific growth parameters (i.e., random effects) to be specified and missing data can be adequately handled under less restrictive data missing assumptions (missing at random; Schafer & Graham, 2002). The first set compared ACT with WLC across the active treatment phase of ACT (pretreatment to 10 weeks). The second set of analyses compared the active treatments (ACT vs. TRT) over the full assessment period (pretreatment to 18-month follow-up). Mediation was performed using a bootstrapped version of the Sobel-test, which tests the significance of the cross-product of the indirect effect (ab-path) with a bias-corrected confidence interval (Preacher & Hayes, 2008).

Results and Discussion

The condition did not significantly differ on any clinical or demographic variable at pretreatment assessment. Attrition was overall low and there was no significant difference on outcome measures or demographic variables at pretreatment between those who completed assessment and those who did not, suggesting that ignorable missing was a reasonable missing data assumption. Results from mixed-effect regression analysis showed that ACT had a statistically significant and substantial effect on the primary outcome (THI) as compared with the WLC over the active treatment phase (between-group Cohen’s $d = 1.04$ at 10 weeks). Similar, there was a significant effect of ACT on insomnia at posttreatment. None of the other secondary outcomes were significant. Mediation analysis suggested that the treatment effect on tinnitus severity (THI) at posttreatment was partially mediated by changes in acceptance (TAQ) at midtreatment (week 5).
Comparisons of TRT and ACT over the full trial assessment period, revealed that ACT was superior in treating tinnitus severity as compared with TRT. Means by condition are presented in Figure 2. The difference between the treatments was substantial at 18 months follow-up (Cohen’s $d = 0.75$), but already at 6 month follow-up the difference was significant. Reliable improvement (i.e., based on the reliable change index) at 6 months follow-up corroborated the finding, by showing that a significantly larger proportion in ACT met criteria for clinically significant improvement than in TRT (54.5% vs. 20%). Thus, the study provides initial support to ACT as an effective treatment for tinnitus as compared with a passive control and an active treatment. Indeed, the long-term follow-up of 18-month is the longest reported in any ACT trial to date. Moreover, the results suggest that ACT exerts its positive effects by means of changing acceptance, providing support to the underlying theoretical model of ACT. Despite these positive observations of the utility of ACT, it should be noted that TRT deviated slightly from the original treatment protocol and adherence was not assessed in either treatment, compromising the integrity of the findings. Furthermore, the effects of TRT are not yet established. Indeed, the effects of TRT reported in this study were at best modest. Hence, ACT needed to be directly compared with traditional CBT, an established effective treatment for tinnitus.

*Figure 2.* Estimated means (with SE) on the primary outcome by condition over time. TRT = Tinnitus Retraining Therapy; ACT = Acceptance and Commitment Therapy.
Study IV. A Randomized Controlled Trial of Internet-Delivered Cognitive Behavior Therapy and Acceptance and Commitment Therapy in the Treatment of Tinnitus

Aim

The aim of this study was to investigate the efficacy of internet-delivered ACT on global tinnitus severity relative (iACT) to internet-delivered CBT (iCBT) and to a control condition (i.e., monitored internet discussion forum) by means of a randomized trial. This was the first study to compare ACT with CBT for tinnitus, and the first to test internet-delivered ACT overall.

Methods

Participants were self-referred and they were recruited by means of advertisement and through an online wait-list for upcoming internet-delivered treatments for tinnitus. The same inclusion criteria were used as in Study III, with some modifications: Participants needed to have moderate to severe tinnitus (defined as a total score of $\geq 38$ on THI); to be able to read and write sufficiently well to be able to work independently with text-based material; and to have access to a computer with an internet connection. In addition, no restrictions were made regarding hearing as made in Study III. In total, 182 participants expressed an interest in taking part in the upcoming study, whereof 99 individuals with tinnitus were eligible and were randomized to one of three conditions: iCBT ($n = 32$), iACT ($n = 35$), or the control condition ($n = 32$). The same outcome/process measures were used as in Study III, but all data, including questionnaire data, were collected online. All participants completed the outcome measures at pre- (approximately 2 weeks prior to the start of treatment), posttreatment (approximately 8 weeks from the start of treatment), and 1-year follow-up. Three measures (the THI, TAQ, Perceived Stress Scale) were also administered at midtreatment (approximately 3 weeks from the start of treatment).

Both active treatments were in the form of internet-delivered self-help, consisting of text-based, visual and audio material that were available for download. The ACT treatment text was inspired by the treatment manual used in Study III but adapted to the delivery format (self-help over the internet), whereas the CBT treatment was based on the shortened version of the previously evaluated and published self-help manual for tinnitus (Kaldo & Andersson, 2004; Kaldo, Cars, Rahnert, Larsen, & Andersson, 2007). In addi-
otion to treatment-specific interventions, both self-help manuals consisted of various interventions that targeted problems commonly experienced by individuals with tinnitus (hearing, sensitivity to noise, sleeping). Throughout the 8 weeks of treatment, participants had regular asynchronous contact with an identified therapist using a closed online contact handling system. Therapists, who were primarily undergraduate students in psychology, treated participants in both treatment arms and were randomly assigned to participants. The mean total time spent per participant each week was approximately 9 minutes and included response to messages, administration, and telephone contact. Participants assigned to the control condition were invited to participate in confidential online discussion forum and were offered treatment after 8 weeks (i.e., at posttreatment).

Two sets of primary outcome analyses were conducted using a linear mixed-effects regression with the full intention-to-treat sample. The first set compared average rates of change between active treatments and control condition over the active treatment phase (i.e., pre- to posttreatment). The second set compared only the two active treatments across all assessment points (pre, posttreatment, 1-year follow-up). Clinical significance was determined based on two criteria: 1) a reliable change on the primary outcome (based on the RCI), 2) high-end state functioning (the cut-off for mild handicap on the THI; Newman, Sandridge, & Jacobson, 1998).

Results and Discussion

There were no significant differences between conditions on any of the demographic or clinical variables at baseline assessment. Similar, there was no significant difference between conditions on outcome or process measures at pretreatment, with the exception for THI, indicating that participants in iACT reported on average lower tinnitus distress than those in iCBT and those in the control condition. However, all analyses controlled for individual differences at pretreatment as a function of condition, as the random intercept (centered at first measurement point) was regressed on condition in the linear mixed-effect regression analyses. Attrition and missing data across conditions and assessments points were low and were not dependent on type of condition or clinical/demographic variables in the overall sample.

Analyses comparing active treatments (iACT and iCBT) with control over the pre-to posttreatment period, revealed that both treatments were superior in treating tinnitus severity (THI; between group Cohen’s d for iACT and iCBT were 0.68 and 0.70, respectively). Figure 3 shows means on the THI over all assessment points as a function of condition. Both treatments were also more
efficacious than control in treating anxiety (HADS-anxiety). In addition, ACT had a significant effect on depression (HADS-depression) and stress (PSS) at posttreatment. Rates of clinical significance were significantly higher in iACT (60%) and iCBT (44%) as compared with control (16%) at posttreatment.

Comparing active treatments over all assessment points, revealed a substantial effect of time across conditions on primary outcome (within Cohen’s $d = 1.34$), but no significant difference in outcomes between conditions was detected (between Cohen’s $d = 0.16$). Analyses of rates of clinical significance at 1-year follow-up mirrored these results, with no statistically significant difference. Results were maintained through follow-up. There was, however, a tendency that participants assigned to iACT increased at faster rate in symptoms from post to 1-year follow-up. Yet, this might have to do with that iACT started on a lower symptom level at average. Indeed, comparing means at 1-year follow-up did not indicate any significant difference.

Collectively, the findings suggest that iACT and iCBT are equally efficacious in treating global tinnitus severity. However, the results need to be interpreted in the context that the control condition could not rule out nonspecific effects and that participants were self-referred and had at average a high level of education (57% across conditions had studied at the university level). More important, however, is the following conclusion, which was reached in the study: “Acceptance procedures may be a viable alternative to traditional CBT techniques for tinnitus, but considerable further research is needed to identify which key components are responsible for therapeutic change and for whom and under what circumstances psychological interventions are most effective.” (p. 11).

Figure 3. Observed means with 95% confidence intervals on the primary outcome by condition over time. CBT = Cognitive Behaviour Therapy; ACT = Acceptance and Commitment Therapy.
Study V. Acceptance as a Mediator in Internet-Delivered Acceptance and Commitment Therapy and Cognitive Behavior Therapy

Aim:
The aim of this study was to examine acceptance (measured with the two subscales of TAQ) as a putative mediator of the effects of iACT and iCBT on global tinnitus severity. This was the first study to directly contrast ACT and CBT for tinnitus at the level of processes of change i.e., moderated mediation. In addition, it represented one of few studies that have examined mediators in psychological approaches to tinnitus.

Methods
Participants and data were obtained from Study IV. The two subscales of TAQ—tinnitus suppression and activity engagement—served as the putative mediators and THI as the outcome, all measured at three time points over the active treatment phase. Multilevel regression analyses were employed to test mediation (i.e., lower level mediation model in the multilevel framework; Kenny, Korchmaros, & Bolger, 2003), extended to moderated mediation (Bauer, Preacher, & Gil, 2006). In these models, time served as a predictor along with the mediator (TAQ), allowing both process and outcome to change over the measurement points. The overall mediation model tested is depicted in Figure 4. As can be seen in the Figure, path a represented the time to mediator association, and path b, the mediator to outcome association controlling for the time effect on the outcome (all paths were estimated jointly in one model). The cross-product of a and b paths was the mediated effect and significance was determined by the asymmetric confidence interval test based on the distribution of the product (MacKinnon, Lockwood, & Williams, 2004; MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). To test for moderated mediation, i.e., whether a- and b-paths varied as a function of treatment, we included cross level interaction effects with condition in the combined multilevel model. Evidence for moderated mediation would be provided if a joint test of difference in a- and b-paths as function of condition would be significantly different from zero (Bauer et al., 2006).
Figure 4. Paths involved in the multilevel moderated mediation model. Mediation was determined by testing whether the joint path of the Level 1 coefficients \((a_j \times b_j)\) was significant and moderated mediation was determined by a joint test of the prediction of \(a_j\) and \(b_j\) coefficients by treatment (a binary variable included at level 2).

Results and Discussion

Reproducing the analyses of changes on primary outcome (THI) over the active treatment phase, revealed a significant and substantial improvement over time irrespectively of condition, but no significant difference between conditions. The asymmetric confidence interval test of the mediated effect, showed that TAQ-suppression mediated the outcome in iACT, but not in iCBT. In contrast, TAQ-activity engagement mediated the time effect on THI across both iACT and iCBT. The joint test of moderated mediation (i.e., whether \(a\) and \(b\) varied significantly as a function of condition) was marginally significant for the TAQ-suppression subscale \((p = .09)\), but was not significant for the TAQ-activity subscale \((p = .5)\) Thus, the results lend some support to that mediation was moderated by treatment, that is, results provide preliminary evidence to that iACT, contrary to iCBT, achieved part of its effect by undermining suppression of tinnitus-related thoughts and feelings. Yet, activity engagement, the ability pursue valued activities despite of tinnitus, mediated the outcome across both treatments, suggesting that this aspect of tinnitus acceptance is not a treatment-specific mediator, at least not in this context of internet-delivered treatments. However, regardless of whether the approaches worked through similar or distinct processes of change, these findings point to acceptance as an important process to target in psychological treatments for tinnitus.

As the mediator and outcome was measured concurrently in the study, it is important to note that these analyses provide little information of temporality
of change, that is, whether change in acceptance precedes and predicts changes in outcomes, rather than vice versa. Notwithstanding this limitation, our trial provided us with an opportunity to directly test how these approaches work and represented a first step to understand the theoretical underpinnings of the models. Still, treatment packages, like the ones used here, consist of a wide variety of interventions, so the specificity of mediation analyses of this sort can be questioned. To test specific theory-driven treatment components in small-scaled analog studies may help to overcome some of the problems associated with exploring mechanisms in large-scaled RCTs.

Study VI. Costs of Suppressing Emotional Sound and Countereffects of a Mindfulness Induction: An Experimental Analog of Tinnitus Impact

Aim

The aim of this experimental study was to examine the underlying dimension of experiential avoidance—experiential openness/acceptance in tinnitus in more detail using an analog design. Specifically, we examined the delayed effects of suppression of an affectively negative sound, mimicking the psychoacoustic features of tinnitus, on ability to persist in goal-directed behavior in the presence of the same sound. Furthermore, we explored whether experimentally induced mindfulness would attenuate this detrimental effect. This was, to our knowledge, the first study to experimentally manipulate attention strategies in the context of emotional auditory stimuli.

Methods

In total, 121 normal hearing adults volunteered, whereof 2 were excluded, resulting in a final sample of 119 participants. The overall experiment was designed to test the delayed effects of suppressing an affectively negative sound on persistence behavior, and to examine whether the specific effects of suppression could be reduced following a brief mindfulness induction. Participants were randomly assigned to conditions of a 2 (suppression manipulation: suppression instructions vs. no instructions) × 2 (induction ma-
nipulation: mindfulness vs. attention control) design. All participants performed two mental tasks in a fixed order while exposed to the auditory stimulus: They completed a memory test and then performed mental arithmetic. Manipulation of suppression was done prior to the memory test and was intended to direct participants to use the mental strategy during the first task. Manipulation of the counterinduction was done prior to the mental arithmetic task (the second mental task). After both tasks, participants responded to a trial demand questionnaire. The time participants could persist in working with mental arithmetic while being exposed to the affectively negative sound in the second task was recorded and served as the dependent variable in the experiment.

The auditory stimulus used throughout the experiment was an artificial high frequency, high-pitched sound (a sinusoidal tone, amplitude modulated at approximately 100Hz, with a center frequency of 4.5kHz), specifically developed to simulate the experience of tinnitus (Heinecke, Weise, Schwarz, & Rief, 2008). Earlier analyses had confirmed that the stimulus was associated with increased psychophysiological and subjective rated stress responses. In addition, we validated emotional valence of the stimulus by allowing 10 participants not involved in the study to rate the sound and 12 sounds selected from the International Affective Digitized system (IADS-2; Bradley, 2007). The stimulus used in the present study was rated as significantly more unpleasant as compared with 4 affectively positive sound as well as 3 out of 4 affectively negative sounds.

All instructions and visual stimuli were presented with E-prime (Version 2.0); responses and duration (ms) were automatically recorded. The sound was presented binaurally in headphones (Telephonics TDH 39P) using an AD 229e diagnostic audiometer with a loudness level at ear level of 65 dB HL. First, all participants completed a total of 7 trials of the Serial recall test. Participants randomly assigned to suppression condition were additionally instructed to suppress the sound from conscious awareness (c.f., Cioffi & Holloway, 1993), and instructed to indicate whenever they heard the sound by pushing a red button in front of them (c.f., Wegner, Schneider, Carter, & White, 1987). Next, all participants listened to an audio recording (300 s). Half of the participants listened to a brief mindfulness exercise (counterinduction condition), informed by previous laboratory experiments on mindfulness exercises and acceptance rationales (Arch & Craske, 2006; Hayes, Bissett et al., 1999), whereas the rest of the participants listened to a documentary on an unrelated topic in a foreign language (attention control condition). Following the mindfulness or the attention control task, all participants worked with mental arithmetic while presented with the same sound. Participants were told that there were an infinite number of math assignments and that they were to solve
as many math assignments as possible, but to stop when they wanted to give up. The length of time (ms) from the first stimulus (i.e., first math assignment) until the participant voluntarily ended the task was recorded and served as the dependent variable in the experiment.

**Results and Discussion**

After the first phase in the experiment, i.e., immediately after suppression manipulation, there were no significant differences on the serial recall test or subjective ratings of trial demand characteristics between conditions. More important, analyses of the length of time a participant could persist in the subsequent task working with mental arithmetic in the presence of the affectively negative sound confirmed our predictions. Means as a function of the two manipulations are presented in Figure 5. Specifically, a 2 × 2 ANOVA revealed a significant suppression (suppression instructions vs. no instructions) by counterinduction (mindfulness vs. control task) interaction effect. In the attention control condition, participants who received instructions to suppress the sound in the first task (during the serial recall test) spent less time persisting than those who received no such instructions (Cohen’s d = 0.57). Thus, suppression was associated with a delayed cost. In contrast, in the mindfulness condition, participants who received instructions to suppress the sound in the first task did not spend less time persisting than those who received no suppression instructions. In fact, observed means indicated that they persisted for a longer time, although not significantly so. Thus, the mindfulness induction between tasks counteracted the detrimental effects of suppression and the effects of the induction seemed to be specific; that is, participants who received suppression instructions seem to benefit from the induction—indeed, they differed significantly from suppression participants in the attention control condition—whereas participants who did not receive suppression instructions did not seem to benefit from the mindfulness exercise. Furthermore, a series of control analyses of subjective rated demand from the first and second part of the experiment did not influence the findings.

The methodology used in the experiment provided a direct test of the overall model of experiential avoidance—experiential openness/acceptance. That is, the methodology of systematically varying both processes, experiential avoidance and acceptance, in the same experiment to see whether one process can counteract the effects of another, provides a stringent test of a model of two theorized opposites of mental control. Indeed, the experiment provides evidence to that the detrimental effect of suppression of an affectively negative
sound can be reduced following a brief mindfulness induction. Thus, these results are overall encouraging.

Although an abundance of experimental literature has been published on suppression of thoughts and emotion, this is most likely the first to examine whether the phenomenon has an analog in the auditory domain. This is of course is a strength of the study. Yet, the suppression effects of auditory stimuli need to be replicated before firm conclusions can be reached here. The same applies to the mindfulness induction. Moreover, as this experiment was performed on normal hearing subjects, we do not know how well the findings transport to individuals with actual tinnitus. Nevertheless, to perform experiments of this kind, directly linked to both theory and technology, seems to hold promise as a way to explore healthy and detrimental processes underlying tinnitus interference.

![Figure 5](image.png)

**Figure 5.** Time of effortful persistence in a mentally challenging task (mental arithmetic) that required participants to ignore emotional task-irrelevant sound as function of suppression manipulation (instructions) and counterinduction manipulation (counterinduction). Induction manipulation followed the suppression manipulation in the experiment; thus, these are the delayed effects of suppression.
Establishing mechanisms, i.e., the basis for a cause, in psychological treatments is one way to create a flexible and progressive science of clinical psychology. A. E. Kazdin, one of the preeminent research methodologists within clinical psychology, has summarized the reasons why research on mechanisms is the future. First, Kazdin (2007) argued, that given the abundance of treatments in use, it is unlikely that all these “different” approaches produce change by different mechanisms. Understanding processes of change can bring order in the field and create parsimony to multiple treatment options and interventions. Second, clarifying mechanisms will answer the key question of how the effects of interventions come about, providing a link between what is done in treatment and outcomes. Third, this, in turn, allows us to enhance interventions to optimize therapeutic outcomes. Fourth, to facilitate results to be transported from research into routine clinical practice, we need to understand which the critical components of an effective intervention are. Fifth, clarifying the mechanisms of an intervention can also help sort out for whom or under what circumstances a particular intervention works (i.e., moderation). Finally, understanding what accounts for change can inform our understanding of human functioning broadly, beyond the context of treatments. Kazdin further argued that to establish a mechanism, we need to rely on multiple sources of information. That is, multiple work, using a broad array of methodologies, need to provide evidence that converge to pinpoint a mechanism.

The aim of the current thesis project was to investigate a proposed process of change in behavioral and cognitive behavioral approaches to the treatment of tinnitus. Specifically, the utility of experiential avoidance—experiential openness/acceptance dimension in tinnitus was examined. By using a variety of methods—RCTs, process/mediation research, experimental component and analog work—multiple lines of evidence were collected and scrutinized. The wide variety of procedures used throughout the thesis project represented a deliberate attempt to explore acceptance/experiential avoidance using a broad scientific strategy within a coherent philosophical and theoretical framework—all in the context of the overriding scientific goal of prediction and influence with precision, scope, and depth.

Three main sets of findings supported the utility of acceptance/experiential avoidance in tinnitus. First, an acceptance-based treatment (i.e., ACT) was
proven to be efficacious in controlled trials. Results from Study III and IV showed that ACT delivered face-to-face or via the internet was more effective than TRT and passive control conditions (wait-list control and monitored internet-discussion forum) in treating global tinnitus severity and equally effective as an established CBT-based protocol for tinnitus. Second, processes research (Study I, III, V) showed that key postulated processes of change were linked to the specific technology of ACT and that these changes in processes were associated with therapeutic outcomes. That is, behavioral measures of acceptance and defusion in-session predicted sustained treatment outcomes and self-report of acceptance of tinnitus partially mediated the outcomes in clinical trials of ACT. Third, experimental manipulations of experiential avoidance and acceptance provided support the underlying dimension (Study II, VI). Specifically, efforts of controlling masking sound were associated with increased tinnitus interference and slower rate of cognitive performance over repeated experimental trials in individuals with significant tinnitus. Finally, in normal hearing participants, experimentally induced mindfulness counteracted reduced persistence in the presence of a tinnitus-like sound stemming from initial effortful suppression of the same sound.

Establishing a Mechanism of Change: Methodological Considerations and Challenges

To establish a mechanism in psychological treatments is not an easy task. Indeed, despite numerous research efforts, we have yet to establish a single mechanism in psychotherapy, irrespectively of condition and treatment type (Kazdin, 2007). For example, cognitive change in cognitive therapy (CT) has failed to show consistently that it is the key therapeutic mechanism of action: “Perhaps we can state more confidently now than before that whatever may be the basis of changes with CT, it does not seem to be the cognitions as originally proposed.” (Kazdin, 2007, p. 8). So what about acceptance/experiential avoidance in the context of acceptance-based treatment for tinnitus, is it a plausible mechanism of change?

Causality is a fundamental axiom of science, yet ironically the formal definition of cause-effect relations has in most circumstances eluded scientists, statisticians, and philosophers (Pearl, 2009). There is, however, a general consensus that three overall criteria need to be fulfilled before a variable can be
considered a cause: a) the variable must be correlated with the outcome, b) the variable must precede the outcome, and c) the correlation must not be spurious (e.g., Cook & Campbell, 1979). Building on these general prerequisites for causality, Kazdin (2007) proposed the following set of criteria in research on mechanisms in psychological treatments: Demonstrate a strong association; establish specificity of association between intervention, mediator, and outcome; show consistency in findings across studies, samples and conditions; manipulate experimentally the intervention to outcome as well as the mediator to outcome relation; establish a timeline between cause and effect; show a gradient in which greater activation of putative causal process is associated with greater outcome; and finally, provide evidence to coherence and plausibility of how the mechanism operates with the broader scientific knowledge base. According to Kazdin (2007), similar conclusions reached across different types of studies can converge in making a particular process of change plausible.

In the following sections, I will consider the empirical studies from these criteria to point out methodological limitations/strengths and challenges for future work.

**Strong Associations**

One initial requirement of a mechanism is the demonstration of a strong association between intervention and hypothesized mediator of change. In addition, there need to be a strong association between the proposed mediator and the outcome. Obviously, these requirements assume that the intervention has an effect on the outcome to begin with. Given this, I will start there. First, the conducted RCTs provide strong support to the hypothesis that acceptance-based procedures can have an effect on tinnitus-related outcomes. ACT had large average effects on the primary outcome across studies and significant proportion of individuals met criteria for clinically significant change in the trials. Second, in all relevant empirical studies a substantial effect on the mediator (i.e., acceptance/experiential avoidance) was observed. Intervention studies provided moderate to large effect sizes on the TAQ. Empirical work showed moderate effects sizes throughout. For example, a very brief mindfulness induction counteracted a moderate detrimental effect of initial suppression ($d = 0.57$). However, the first process study (Study I) could not evaluate whether the observer rated processes in-session were an effect of intervention. On the other hand, as discussed earlier, although no evidence was provided to the claim, the study does not rule out the possibility that these processes were in fact a result of intervention. Still, further work needs to establish whether interventions targeting acceptance-related processes have an
effect on behavioral measured processes. Small analog component studies are well suited for this goal. For example, a brief defusion exercise (Masuda et al., 2004) can be used to see whether it changes verbal defusion behaviors in relation to target outcomes (e.g., reduced believability).

Regarding the mediator to outcome relation, evidence was provided to support strong associations between changes in acceptance and outcomes across studies. Changes in acceptance of tinnitus mediated the outcomes of treatment effects of ACT in relatively small samples (Study V, III). Hence, the correlations (i.e., $b$-paths) were large in these situations. For example, the sample correlation between TAQ (measured at 5 weeks) and THI (measured at 10 weeks) in Study III was $r = -.76$. Effect sizes in the similar range were found in Study I in which observer rated in-session processes were correlated with the long-term outcome. Similar, effects of the experimental studies on outcomes (i.e., tinnitus interference, cognitive performance measures, goal-directed persistence) were in the moderate range. Observed experimental effects are particularly noteworthy given that the manipulations were brief and, for most part, done without knowledge or intent of the participant. Collectively, the results provide support to the overall mediation model in which the intervention is correlated with the outcome, proposed mediator is correlated with the intervention, and outcome is correlated with the mediator—in all cases with strong associations. I now turn to the specificity of the findings.

**Specificity**

An important requirement to establish a mechanism is to show the specificity of association between intervention, proposed mediator, and outcome. Although findings reported in the RCTs conclusively support the overall effect of ACT in the treatment of tinnitus severity, the evidence to the specificity of effects on outcome/process is less convincing. Passive control conditions (i.e., monitored internet discussion forum, wait-list) used in the trials could not rule out nonspecific effects; at best they controlled for general emotional and social support and spontaneous improvement. Although an active treatment (TRT) was used in Study III that potentially could rule out placebo/nocebo responses (e.g., expectations of improvement), the amount of contact with therapist and the type of intervention received differed substantially between conditions as a consequence of the differences in original treatment protocols. In terms of testing the specific effect of ACT, the best comparison condition was traditional CBT, as examined in Study IV. The study went to great lengths to make the comparison as equal as possible in all respects other than treatment-specific activities. Although the self-help manuals differed slightly
in text length, both treatments were delivered over 8 weeks with therapists randomly assigned to participants in both conditions. There were no difference in the amount of therapist time, attrition, or number of completed modules between iACT and iCBT. Yet, despite of this—or perhaps because of it—the study failed to support the hypothesized superiority of ACT over traditional CBT in the treatment of tinnitus severity. There are number of explanations why no difference in outcome was detected in the study. If we disregard the possibility that there actually is no meaningful difference in the population(s), the most straightforward explanation to the lack of significant difference is statistical power. Though the effect size estimate between conditions on the primary outcome was small ($d = 0.16$), the estimate itself also varies with sample size and the overall sample size was relatively small in the study.

However, a more intriguing explanation to the null finding is that the mechanism of change varies as a function of treatment and/or another moderator variable. This could imply that a subgroup of individuals respond better to ACT than CBT, whereas another subgroup respond better to CBT than ACT, resulting in a null effect in the overall sample. Some indirect evidence reported in Study V and VI supported this notion. First, moderated mediation analyses provided evidence to that iACT worked through altering an ineffective avoidance strategy (i.e., suppression), but that iCBT did not. Second, a brief mindfulness exercise counteracted the specific detrimental effects of suppression of tinnitus-like sound in normal hearing participants. Both of these findings point to the specificity of acceptance-based procedures, at least in these circumstances. More important, the results indicate that those individuals who frequently adopt ineffective avoidance strategies (e.g., suppression) may profit from an acceptance intervention. However, much more work is needed here. Of particular importance is research focusing on mediated baseline by treatment moderation in which the mediated effect depends on the baseline level of the mediator (MacKinnon, Fairchild, & Fritz, 2007). For example, a plausible scenario is that the effects of ACT on outcome are stronger for individuals high on avoidance strategies at baseline (an explanation I will discuss in depth later on). Indeed, some preliminary results have been presented in support of this assumption in the context of ACT for other health issues. Masuda et al. (2007) found that ACT had a stronger effect on stigma towards mental illness as compared with psychoeducation for individuals low on psychological flexibility (i.e., the overall ACT process), whereas the treatments where equally effective when participants’ initial levels of psychological flexibility were not accounted for in the analyses.

Studies in the current thesis project have exclusively focused on one process (by using measures such as TAQ or ADPM). To further demonstrate the spec-
ificity of the process of change, we need to include multiple plausible mediating variables to show that these do not account for change. In such comparisons, it is important to remember that ineffective avoidance strategies among individuals with tinnitus can take on many forms. Indeed, suppression of thoughts/feelings is not the only way people try to alter or control the experience of tinnitus and detrimental effects can be a direct consequence of other control efforts as shown in Study II. Measurements that encompass a broad array of avoidance strategies in tinnitus have begun to appear in the literature (Kleinstäuber et al., 2012). It might, however, be critical not to rely solely on self-report to assess these plausible mediators, because changes might come about as a result of patient expectations of the particular treatment and covariation between outcome and process can be explained by shared method variance. Study I represented an attempt to overcome some of the limitations associated with self-report, but all measurements, including all forms of behavioral or experimental approaches, are valued. Furthermore, given the results of the moderation mediation analyses in Study V, and results from initial unpublished data from our research group (Hesser, Bånkestad, & Andersson, 2012), it might be crucial to separate avoidance strategies from appetitive approach behavior in tinnitus; that is, not treat them as mere opposites of one another—both constructs can be of importance in their own right in relation to outcome and be linked to different procedures (a line of reasoning which is developed later on). To sum, further research is needed to distinguish specific technique-to-process-to-outcome relations, but preliminary evidence is provided to support the specificity of acceptance procedures in the treatment of tinnitus.

**Experimental Manipulation and Timeline**

At the core of a useful strategy aimed at identifying a mechanism is experimental manipulation. Why? The answer is related to the concept of causality. Throughout history, statisticians have struggled with the concept because mathematical formulas are all symmetrical, whereas cause-effect relations are unidirectional by nature (Pearl, 2009). In his seminal book on causality, Pearl (2009, p. 410) wrote that the only method for testing causal relations permitted in mainstream statistics is the randomized experiment. A mechanism involves several causal relations. We need to demonstrate a causal relation between intervention (independent, X) and proposed mediator (M), and between mediator and outcome (Y) as well as between intervention and outcome. If all variables (X, M, Y) involved in the mediation model are measured concurrently it is very difficult to distinguish one estimated model
Randomization to X (e.g., intervention) is part of the solution because X then precedes M and Y, and spurious correlations are controlled for by means of randomization. Mediation analyses conducted in the present thesis project (Study III, IV) were all done within a randomized controlled design. This is a strength of the work as it provides strong support to causal claims of how intervention influence the mediator/outcome. So what about the M to Y relation controlling for X in the same context, does this also reflect a causal relation? It is not a true causal effect because the M to Y relation is correlational. This is due to that the association is not a result of randomization, i.e., individuals can “take” on different levels of the mediator rather than being experimentally assigned different levels.

One way to go beyond correlational statements in terms of the M to Y relation in RCTs is to establish the timeline. That is, evidence must be provided to support that the mediator temporally precede the outcome, i.e., proposed mediator must be assessed before the outcome and must be assessed early to show that it actually changes before the outcome (Kazdin, 2007). Both of the mediator analyses reported here failed to do so—yet, obviously, untested temporality of change is not a proof of a reverse association in which change in the outcome precedes change in the mediator. Although Study III used the midassessment in the evaluation of mediation, a substantial improvement might have occurred in the outcome at that time, providing little evidence to the direction of effect between acceptance and tinnitus severity.

Study I, however, provided a bit more tangible evidence to temporal precedence, a fact recognized even among scholars critical of ACT (Öst, 2009). In that study, assessments of the primary outcome on a session-to-session basis permitted more detailed analyses. Specifically, no average population change on outcome was detected at session 2 at which point the proposed mediators were measured and correlated with long-term outcome. Analyses in which individual outcome changes made prior to measured process variables were statistically accounted for did not alter the findings. Moreover, earlier changes in outcomes were not correlated with later rated processes variables. The study represented a step in the right direction to prove a causal relation, or at least temporal precedence.

Yet, the above analysis assumes that the process and the outcome measured at different time points over the course of therapy are randomly drawn independent observations from normal distributions. This might not accurately capture the complexity of longitudinal process data. Rather, individuals are
likely to change at different rates on both the process and the outcome over course of treatment. In this scenario, where time is nested within individuals, analyses that adequately model individual differences in change are more appropriate (McArdle, 2009). I have been involved in couple of research projects in which a design with repeated-measured processes and outcomes was used to capture processes of change in large-scaled trials for other health conditions (e.g., Ljótsson et al., 2012). If we aim to test temporality of change in a RCT, this is probably the best way to go about doing it.

Still, to explicitly manipulate the process might be an even better way to test the M to Y relation. That is, a useful strategy is to conduct an experiment in which the mediator is in fact altered or systematically varied across experimental conditions (MacKinnon, 2008). Both experiments reported here (Study II, VI) represented such an attempt. Although a couple of alternative explanations can be given to the results presented in these studies, findings were overall in accordance with the theoretical model. Most significantly, as noted earlier, study VI provided a stringent test of the overall model by systematically varying both end points of the theorized dimension of experiential avoidance—experiential openness/acceptance. One might argue that both of these experiments come with a cost of reduced external validity. This is true to an extent. Yet, when it comes to answer questions about mechanism, the controlled setting still might be the right way to go. Kazdin (2007) wrote the following on the topic of laboratory studies of therapeutic processes: “Controlled studies of therapy in research rather than clinical settings are more important now than ever before. The careful control afforded such research is precisely what is needed to identify mediators and mechanisms” (p. 20). Thus, further experimental work that aims to assess and alter the mediator directly holds promise. In particular, experiments that varies two (or more) mediators in the same experiment to rule out one mediator while at same time providing evidence to another, or experiments in which participants are assigned to low, medium, and high levels of the same mediator to assess if outcome varies as a function of manipulated levels, would be extremely useful (MacKinnon, 2008).

In sum, the work reported seems to provide some evidence on behalf of a causal relation between proposed mediator and the outcome. Still, a substantial amount of work needs to be done here.
Consistency, Coherence and Plausibility

To identify a mechanism in psychological treatment is not a result of a single investigation. Rather, understanding the basis for a cause is a consequence of the convergence of multiple lines of work, where each study provides evidence that converge to make a particular process of change plausible (Kazdin, 2007). By using a broad strategy, studies can collectively address several different criteria. The present thesis project was deliberately set up to encompass a variety of methods to examine the utility of the dimension in detail. Indeed, as discussed above, the evidence for different criteria and the clarity of demonstration varied as a consequence of the study. For example, one process study (Study I) provided initial evidence to temporal precedence between the mediator and the outcome, whereas two other studies did not (Study III, V). Yet, these studies instead explicitly tested all paths in the mediation model in the context of a randomized controlled trial, providing support to a cause effect relation between intervention and mediator. Hence, collectively, these different types of studies converge on multiple criteria of a mechanism.

An essential requirement is that the explanation given to a cause (mediator, mechanism) is plausible and coherent with the broader scientific knowledge base. The dimension of acceptance/experiential avoidance seems to hold its own in terms of this requirement. As reviewed in detail in the background, there seems to be growing evidence to the utility of the dimension in human functioning broadly, as recognized not only by the founders of the concept (Hayes et al., 1996) but also by preeminent researcher within the broader scientific community of clinical psychology (Arch & Craske, 2008; Barlow et al., 2004). In addition, there is a significant overlap with other key constructs within basic science found in the literature on emotional and cognitive regulation strategies. Most significantly, the key assumption that suppression only works in the short time and can have detrimental effects in the long term is supported in experimental work (e.g., Werner & Gross, 2010). There is also a steadily increasing body of work that supports the beneficial effects of acceptance in laboratory settings (Kohl, Rief, & Glombiewski, 2012; Levin et al., 2012).

The theoretical implications of the dimension in tinnitus were also examined in detailed in the background of the thesis. Briefly, the idea seems to be supported broadly by research on coping strategies in distressed individuals (e.g., avoidance coping; e.g., Kleinstäuber et al., 2012), neurophysiological emotional responses in significant tinnitus (De Ridder, Vanneste et al., 2011), and on evaluative functions and cognitive distortions underlying vigilance and avoidance in tinnitus (Cima et al., 2011; Weise, Hesser, et al., 2012). In addition, initial work on the ability to persist in values-based behavior despite of
Tinnitus/acceptance of tinnitus (e.g., Westin, Hayes et al., 2008) and on mindfulness-based treatment approaches have reported findings in accordance with the work presented here (e.g., Philippot et al., 2011). Accordingly, the dimension not only seems to be a plausible process in tinnitus, but also marry well with a number of other key constructs in the scientific knowledge base.

Do Not Forget the Context: Theoretical and Clinical Implications

The Utility of a Functional Dimensional Process Approach to Treatment

Up to now, I have argued that the evidence provided in the empirical studies support that acceptance/experiential avoidance could be conceived as a plausible mechanism. Yet, based on the philosophical framework adopted in the present thesis project, mechanisms are not “out there” to be found. Rather, causality statements of this sort serve as way to communicate how we “behave effectively in given contexts for given purposes” (Hayes, Levin et al., 2011, p. xx, advanced online publication). Said in another way, what is true is defined by the outcome we want to predict and influence in a given context. That implies that a mechanism can be “true” in one context but “false” in another. So what then is the practical use of the term “mechanism” in this philosophical context? The term implies that a functional dimensional process such as experiential avoidance—experiential openness/acceptance can be successfully applied in various contexts in relation to the predefined scientific goals of prediction and influence. Thus, it is determined by its utility rather than whether it corresponds to a cause influencing “true” entities in the world. Indeed, as noted by several philosophers over the years, causes are seldom (or never) observed, but inferred from repeated observations of given phenomena (Pearl, 2009), and are often directly defined in relation to the effects they produce (c.f., Rubin’s Causal model; Rubin, 1974). Given this, we might be better of talking about “causes” from a pragmatic standpoint.

These ideas might have practical implications. Rather than just focusing on whether a particular intervention works, we may need to consider when it works. What is adaptive is dependent on the context and is a direct function of the problem we want to address. For example, a negative interpretation of stimuli will cause sensory monitoring to backfire (Ahles et al., 1983; Cioffi,
1993), and certain avoidance attention strategies (e.g., distraction) might be very useful in certain circumstances (e.g., short-term duration of pain in the context of an attainable goal; Cioffi, 1991). Likewise, a particular procedure can be effective for certain individuals or in certain circumstances. If we disregard this possibility in our scientific approach, we might miss key associations.

A theory-driven functional dimensional process approach to treatment development, testing and implementation, can be very useful here. Clinicians can predict the probability of a given procedure in impacting a predefined outcome in a particular situation on the basis of whether the procedure is likely to affect the process underlying the outcome. Similar, if a particular procedure fail in producing a target outcome, the approach gives clues to why it failed to do so. Innovative techniques aimed at targeting these processes can be developed and adjusted to the situation. In this way, the procedures we use are directly linked to the assessment—and assessment is always situated in a given context (Strosahl & Linehan, 1987). This might also have direct bearing on effective training and dissemination of empirically-supported treatments (c.f., Barlow et al., 2004).

The present thesis project represented a first step toward conceptualizing tinnitus-related problems by key functional processes and evidence was also provided to the utility of such a conceptualization. This might be particularly important in the case of tinnitus given the observed heterogeneity among individuals with the symptom, and that the sound itself gives little guidance that can direct treatment strategies. Most relevant, of course, is the fact that individuals with tinnitus vary in the degree to which the symptom impact daily functioning and quality of life. Broadly, the thesis project gives clues to why individuals develop and maintain symptom-specific distress and, more important, clues to how we influence such processes. This might be critical for further treatment developments in the area.

Acceptance in Behavioral-based Treatments: How does it Work?

The present thesis project was set up to test the utility of the dimension broadly, rather than to test specific hypothesis about how it works in a given situation. As noted in the background of this thesis, acceptance may have multiple links and underlying processes. Given that the studies provide encouraging findings, it might be sufficient, for now, to conclude that the dimension seems to be useful in tinnitus. Indeed, before “running ahead of the data”, we may be well served remembering the words of Skinner: “It is true
that we could trace human behavior not only to the physical conditions which shape and maintain it but also to the causes of those conditions and the causes of those causes, almost ad infinitum, but we need take analysis only to the point at which effective action can be taken” (Skinner, 1974, p. 210).

On the other hand, there are some intriguing findings that deserve our attention and can enhance our understanding of how and when psychological treatments work. Most significantly, the results that were not directly predicted by the theoretical model are perhaps most noteworthy. For example, why did not iACT produce greater effects on the outcomes than iCBT, and, more important, why was activity engagement—the ability to engage in values-based behavior despite of tinnitus—an equally strong mediator of the outcomes of iCBT and iACT? In the following sections, I will discuss some potential mechanisms underlying acceptance in relation to the divergent procedures used in CBT and in ACT. As I will argue, these two unexpected findings may well be linked. Although the following discussion is necessarily speculative, these ideas may generate several testable hypotheses that can be addressed in further research.

**Emotion-regulation in the treatment of tinnitus.** Tinnitus severity can be conceptualized as a “negative affective” condition, as supported by the well-established link between emotional problems and tinnitus distress (Andersson, 2002), and by emerging neurophysiologic data on the emotional neural circuits underlying distressing tinnitus (De Ridder, Elgoyhen et al., 2011). As such, treatments targeting the emotional aspects of the sensation are most likely to succeed in treating the adverse effect of tinnitus. This is probably why CBT has enjoyed success in the area where other approaches repeatedly have failed (Hesser, Weise, Westin et al., 2011). In recent years, within the CBT-based treatment literature on emotional disorders, there has been a growing interest for using applied principles linked to basic science on emotion (Barlow et al., 2004). Most significantly, Barlow and colleagues proposed a unified treatment protocol for emotional disorders (anxiety and mood disorders) including treatments components with three overall aims: a) changing antecedent cognitive reappraisals, b) preventing emotional avoidance, and c) promoting counteractive emotional action tendencies. These ideas mesh nicely with the theoretical framework outlined in the current thesis project. As such, these broad aims can serve as a starting point for discussing the mechanisms by which acceptance produce its positive effects in behavioral-based treatments for tinnitus.

First, as noted in the background of the thesis, acceptance may alter the stimulus function of tinnitus, reducing negativity to the sensation. By paying attention in a neutral way to the auditory sensation, the negative emotional
tone can be decoupled from the experience or the auditory sensation can acquire a new function that does not carry threatening meanings. This can readily be reformulated as an antecedent-focused strategy, as examined in the emotion regulation literature (i.e., reappraisal; Gross, 2002). Second, acceptance may counteract avoidance of both tinnitus and associated negative emotional sensations, preventing detrimental and paradoxical effects of avoidance strategies. Third, acceptance may facilitate behaviors that modify action tendencies, which either dysregulate emotional responses to tinnitus or decrease values-based responses. Moreover, it has been argued that an integral part of exposure treatment is to prevent action tendencies of fear and anxiety by facilitating new action tendencies (Barlow, 1988), a notion that more recently has found some support in research on inhibitory learning (Craske et al., 2008). Hence, acceptance may also facilitate new learning by the means of exposure processes. Acceptance may theoretically facilitate adaptive responses by altering one or more of these processes in tinnitus.

**Emotion-regulation in behavioral treatments.** An intriguing finding is that activity engagement mediated the outcomes across both iACT and iCBT. These results point to that both iCBT and iACT changed one integral part of acceptance, namely ability to change or persist in values-based responses despite of tinnitus. We concluded in that study (Study V) that activity engagement could potentially be a key mechanism of change in behavioral-based approaches to tinnitus. It is plausible that both CBT and ACT promoted responses that were incompatible with dysregulatory action tendencies. As noted above, this might also facilitate new learning in relation to fear-conditioned stimuli. The CBT-protocol tested here consisted primarily of applied relaxation. Given these results, one could argue that this intervention does not work through reducing tensions and general stress activation, but rather through promoting a context in which more adaptive responses can be made, specifically actions that decreases dysregulatory action tendencies in relation to fear and anxiety. Some indirect evidence from other areas can be provided in support of this assumption. For example, when relaxation exercises are presented to individuals as a way to reduce negative emotions or distress, the results seem contraproducive, as supported both by treatment studies on anxiety disorders (Barlow et al., 2004) and laboratory studies on healthy individuals (Wegner, 1994). More recent work has theorized that key elements of applied relaxation, such as cue detection and self-monitoring, may work through enhancing responses such as acceptance and mindfulness (Hayes-Skelton, Usmani, Lee, Roemer, & Orsillo, 2012). In tinnitus treatment, applied relaxation may promote ability to stay in contact with emotional and stress responses associated with the auditory sensation, while at the same time preventing actions tendencies (avoidance behavior) that maintain fearful connotations.
Encouraging approach behavior is most likely an important element in psychological treatments for tinnitus. From the discussion above, and the results provided in Study V, it seems reasonable to suggest that both ACT and CBT changes the emotional experience of tinnitus, in part, by substituting action tendencies (e.g., approach behaviors) associated with alternative emotions in the presence of tinnitus. There are, however, reasons to argue that acceptance-based interventions specifically target avoidance strategies in tinnitus. As noted earlier, changes in the tendency to suppress thoughts and feelings associated with tinnitus mediated the outcomes in iACT, but not in iCBT. Moreover, experimentally induced mindfulness counteracted the specific effects of a suppression rational in relation to an affectively negative sound that simulated the psychoacoustic features of tinnitus.

Although there is a considerable overlap between promoting approach behaviors/modifying action tendencies and reducing ineffective avoidance, there may still be subtle but key differences between these two aims in treatments. Indeed, as noted by Barlow et al. (2004) in the context of emotional disorders, individuals can engage in new action tendencies (e.g., approach) while simultaneously engaging in avoidance behaviors (e.g., distraction). This may be of particular importance in tinnitus. For example, an individual with tinnitus may do “everything” attending social activities, concerts etc., while at the same time engaging in avoidance strategies (e.g., distraction, using background sounds to mask tinnitus). Indeed, tinnitus is not characterized by a specific behavioral avoidance pattern and avoidance strategies used among individuals with tinnitus are often subtle. Still, specific attempts to control or avoid tinnitus can be associated with detrimental effects, as demonstrated by the work presented here and research on coping in tinnitus. Thus, attention to strategies that encourage approach behavior as well as strategies that prevent ineffective avoidance (e.g., suppression) in treatment might be critical.

Acceptance-based procedures may play an essential role in the reduction of avoidance in tinnitus. It follows from this, that the degree to which individuals engage in avoidance strategies may moderate the impact of acceptance-strategies on outcome. That is, acceptance may be particularly useful for individuals who rely on strategies that aim to control or avoid tinnitus and associated negative emotional responses.

**Why avoidance? A conceptualization based on level of fear activation.** The degree to which individuals engage in avoidance strategies may vary. I can only speculate in why certain individuals with tinnitus engage in avoidance strategies. It has been suggested that attempts to suppress thoughts stem, among others, from initial concerns about the social expression of these internal events. Although this may also be relevant in the case of tinnitus, the
very sensation may be a key source to avoidance in tinnitus (c.f., suppression of pain; Cioffi, 1993). Once negatively evaluated, tinnitus may prompt avoidance as any other threatening event. Through repeated associative learning, associated internal events and tinnitus may come to take on more threatening meanings, prompting more attempts of avoidance. This may, over time, cause a vicious cycle of increased emotional arousal and more unsuccessful attempts of avoidance (c.f., Wegner, 1994; Werner & Gross, 2010).

Recent research and theories on anxiety can generate hypotheses about why certain individuals engage in these costly strategies. Based on clinical, ethological, and neurophysiologic evidence, preeminent researchers have suggested that there are fundamental distinctions between anxiety and fear (e.g., Barlow, 1988). Anxiety is as complex blend of negative emotions and cognitions that is oriented to the future, whereas fear is a basic emotion that activates the “fight-or-flight” response of sympathetic nervous system (Mineka & Oehlberg, 2008). Anxiety often results in a state of overarousal and tension, but not in a fight-or-flight response. These negative emotional states may activate different overt behaviors. From an evolutionary perspective, it has been argued that our defense fear system produces different physiological responses and overt behaviors depending on threat imminence. That is, fear behaviors (fight or escape/avoidance) are likely to be used in the context of immanent threat, whereas anxiety behaviors (increased vigilance, cautious behaviors) are promoted by less explicit, more diffuse, cues of threat (Mineka & Oehlberg, 2008).

Of critical importance in the argument above, is this qualitative difference in behavioral responses depending on level of fear system activation. One could argue that degree to which individuals with tinnitus engage in avoidance strategies is a function of the level of fear activation associated with the experience of the auditory sensation. Specifically, when tinnitus is not associated with threat, the individual may go about daily activities without so much as noticing the sensation. However, when anxiety, even very slightly, becomes coupled with tinnitus, behavioral responses (e.g., vigilance) are optimized to adequately deal with future threats. Moreover, when tinnitus is actually interpreted as a threat in a given situation, a fight-or-flight response can be activated, prompting effortful attempts of escape or avoidance. Indeed, analyses of symptoms in anxiety and mood disorders suggest two relatively independent clusters of symptoms—a fear/panic emotional state or general state of anxious worry (Brown, Chorpita, & Barlow, 1998). Similar, individuals who are distressed by tinnitus could potentially be classified into two broad groups. One could be characterized by anxious apprehension and worry about future consequences of tinnitus (e.g., worrying about tinnitus getting worse, hearing difficulties etc.), and one could be characterized by significant
autonomic arousal and fight-or-flight action tendencies. This conceptualization of tinnitus severity can have direct clinical implications in terms of treatment procedures, as argued above. In addition, as avoidance seems to be associated with the severity of tinnitus, it is also plausible that treatment effects vary as a direct function of severity. Yet, obviously, these ideas remain untested in tinnitus.

Main Conclusions

The overarching aim of this thesis was to explore the utility of a functional dimensional process in tinnitus, experiential avoidance—experiential openness/acceptance. Multiple research efforts, using a wide variety of methods, converged to provide evidence for the utility of the dimension in tinnitus. Specifically, results from RCTs supported that acceptance-based procedures may be a viable alternative to traditional CBT-based procedures in the treatment of tinnitus severity. Process and laboratory research found evidence for that acceptance-based procedures may specifically target an avoidant behavioral pattern in tinnitus (e.g., suppression strategies) and may, hence, potentially be more useful for individuals who display such a coping attempt pattern. Experimental research also supported that such coping attempts were associated with increased distress and interference. In particular, as shown here, efforts to suppress tinnitus-like sound from conscious awareness and a preoccupation with attempts to mask tinnitus by using background sounds, resulted in detrimental effects over time. However, there were also some hypotheses that were not supported by the data. Most significantly, the ability to pursue valued-activities despite of tinnitus was an equivalent mediator in both traditional CBT and ACT. This raises the question whether willingness-enhancing strategies, as promoted in ACT, are necessary to get individuals to engage in goal-directed behaviors in the presence of tinnitus.

A substantial amount of more work needs to be done on processes of change in treatments for tinnitus, in particular on traditional CBT-based interventions (e.g., applied relaxation). Experimental component analog studies seem well suited for this goal. A comprehensive understanding of the physiological, cognitive, emotional and neurobiological correlates of tinnitus will most definitely advance the treatment literature in the area. Most significantly, future investigations should to a much higher extent integrate knowledge from basic science on emotion and processing of external auditory stimuli. For example, some exciting experimental work on emotional conditioning of sound has recently been published (Asutay & Västfjäll, 2012). Knowledge from this area and research on cognitive processing of auditory stimuli (e.g., irrelevant-
speech effect; Jones & Macken, 1993) and on the behavioral characteristics of (dis-) habituation (e.g., Rankin et al., 2009) can be integrated to test specific hypotheses about tinnitus interference and distress.

Concluding Remarks: Are We Heading in the Right Direction?

I have come to argue that process research—very broadly defined—is pivotal for further treatment development. The idea that clinical procedures should be based on theory-driven principles is not a new one. Yet, it seems like we (read: research community) sometimes lose track of the very fundamental idea that our treatment procedures should be closely tied to processes of pathology or human functioning more broadly. For example, as mentioned earlier, the largest RCT of a CBT-based protocol for tinnitus published to date provides little clues to which components or procedures that should be used to treat the average patient suffering from tinnitus. Causal effects are always relative (at least when considered in the average causal effects context; Rubin, 1974), which basically means that if our independent variables are poorly operationalized and the comparisons we use in RCTs cannot rule out alternative explanations, these research efforts have little to offer a pragmatic science. As I have argued, it is time to consider the research strategy that best serves our own interest—developing effective procedures for those who are suffering. The current thesis project has pointed to signs that a strategy that focuses on key functional processes can be very useful.

My thesis project focused on a single dimension. Obviously, this does not cover all potential processes relevant to this research (i.e., CBT-based treatments for tinnitus). Thus, I remain humble in the fact that this project cannot, and should not, as a single attempt provide final answers to the complex phenomenon under investigation. Rather, the thesis project can be seen as an example within a broad scientific approach, which ultimately aims to develop useful theories in relation to tinnitus severity and treatment. The overall success or failure of the approach rests not in whether the dimension explored here is ultimately proven to be “valid”; rather, the approach should be evaluated by examining whether we move toward long-term scientific progression using this overall scientific strategy. To that end, it is important to remember that scientific progression generally unfolds slowly over time. My contribution represents a first step within a broad scientific approach that, hopefully,
over time, can lead to the development of more potent interventions in the
treatment of tinnitus. As such, the thesis project represents a significant step
toward a values-based end, rather than an end in itself.
REFERENCES


Ett fantastiskt stort tack går också till…

Vendela Zetterqvist Westin. Kan bara instämma med vad du Vendela skrev i ditt tack till mig då du disputerade, nämligen att jag var hennes närmaste forskningskollega – dito. Vendela har en enorm förmåga att se det positiva i alla situationer och att se förändringspotential, även i de mest omöjliga situationer (du vet nog vad jag pratar om Vendela). Hon är en duktig forskare och kliniker och går in för saker med passion och hjärta. Jag vill verkligen passa på att tacka dig Vendela för allt gott samarbete över åren, i synnerhet med studie III.

Jörgen Öberg, Marie Blom, Nina Bendelin och Tore Gustafsson för er insats som bedömare i studie I. Ni bidrog verkligen till att forma ADPM. Tack för mycket lärorika söndagsdiskussioner på kliniken.

Steven Hayes. Thank you for your valuable contribution to Study I. Your work and innovative ideas for creating a progressive science are truly inspiring.

Carl Emil Pereswetoff-Morath. Stort tack Emil för allt ditt arbete med studie II.


Peter Molander och Mikael Jungermann (aka e-prime killarna). Det var kul att designa och genomföra studie VI tillsammans med er. Tack för era insatser (och för att ni hittade den röda knappen som var galet stor!).


Maria Jannert och Lise Bergman Nordgren (aka klinikoskorna). Ni lyser upp min vardag med skratt och galenhet. Tack för att ni hjälper på er själv på det sätt ni gör och förklarar saker i världen så att till och med jag förstår (typ ”Hugo, vi kan kalla det här en blomma”).

Cornelia Weise. Tack för gott samarbete i flera studier. Hoppas att vi kan fortsätta att samarbete på distans (Schwedische kein problem?!).

Brjánn Ljótssson och Erik Hedman (aka de härligt maniska Stockholmskillarna). Det känns kul att brottas med er intellektuellt i olika roliga och spännande forskningsprojekt. Jag hoppas att vi kan fortsätta med detta i många år framöver. Brjánn - jag hoppas också att få se mer mejl i inboxen klockan 3 på morgon som handlar om hur man omvandlar residuella till SD i LMM – det typen av galenhet uppskattar jag något enormt.

Kirk Strosahl. Thank you Kirk for being willing to train me for a couple of months. It was truly an inspiring and life-changing time in my life.


Ett stort tack till alla studenter på psykologprogrammet som jag träffat i undervisningssammanhang. Ni utmanar mig och formar mig till en bättre lärande.

Nina för att du delade viktiga och fina stunder i mitt liv.


Pappa och Mamma. Utan er hade jag inte funnits till (och inget av detta hade varit möjligt). Den blandning av estetik, kreativitet, passion/hängivenhet och noggrannhet som ni införlivat i mig är nog det som till stor del format mig till den forskare jag är idag.
Studies from the Swedish Institute for Disability Research

1. **Varieties of reading disability**  
   Stefan Gustafson  

2. **Cognitive functions in drivers with brain injury – anticipation and adaptation**  
   Anna Lundqvist  

3. **Cognitive deafness**  
   Ulf Andersson  

4. **Att lära sig leva med förvärvad hörselnedsättning sett ur par-perspektiv**  
   Carin Fredriksson  
   ISBN 91-7373-105-6, 2001

5. **Signs, Symptoms, and Disability Related to the Musculo-Skeletal System**  
   Gunnar Lundberg  

6. **Participation – Ideology and Everyday Life**  
   Anette Kjellberg  

7. **Föräldrar med funktionshinder – om barn, föräldraskap och familjeliv**  
   Marie Gustavsson Holmström  
   ISBN 91-7203-500-5, 2002

8. **Active wheelchair use in daily life**  
   Kersti Samuelsson  

9. **Två kön eller inget alls. Politiska intentioner och vardagslivets realiteter i den arbetslivsinriktade rehabiliteringen**  
   Marie Jansson  
10. **Audiological and cognitive long-term sequelae from closed head injury**  
Per-Olof Bergemalm  
ISBN 91-7668-384-2, 2004

11. **Att vara i särklass – om delaktighet och utanförskap i gymnasiesärskolan**  
Martin Molin  
ISBN 91-85295-46-9, 2004

12. **Rättvis idrottsundervisning för elever med rörelseshinder – dilemma kring omfördelning och erkännande**  
Kajsa Jerlinder  
Licentiate Degree, 2005

Per-Inge Carlsson  
ISBN 91-7668-426-1, 2005

14. **Hearing and cognition in speech comprehension. Methods and applications**  
Mathias Hälgren  
ISBN 91-85297-93-3, 2005

15. **Living with deteriorating and hereditary disease: experiences over ten years of persons with muscular dystrophy and their next of kin**  
Katrin Boström  
ISBN 91-7668-427-x, 2005

16. **Disease and disability in early rheumatoid arthritis**  
Ingrid Thyberg  
ISBN 91-85299-16-2, 2005

17. **"Varför får jag icke följa med dit fram?" Medborgarskapet och den offentliga debatten om dövstumma och blinda 1860-1914**  
Staffan Bengtsson  
ISBN 91-85457-06-X, 2005

18. **Modalities of Mind. Modality-specific and nonmodality-specific aspects of working memory for sign and speech**  
Mary Rudner  
ISBN 91-85457-10-8, 2005
19. Facing the Illusion Piece by Piece. Face recognition for persons with learning disability
Henrik Danielsson
ISBN 91-85497-09-6, 2006

20. Vuxna med förvärvad traumatisk hjärnskada – omställningsprocesser och konsekvenser i vardagslivet. En studie av femton personers upplevelser och erfarenheter av att leva med förvärvad traumatisk hjärnskada
Thomas Strandberg

21. Nycklar till kommunikation. Kommunikation mellan vuxna personer med grav förvärvad hjärnskada och personernas närstående, anhöriga och personal
Pia Käcker

22. ”Aspergern, det är jag”. En intervjustudie om att leva med Asperger syndrom
Gunvor Larsson Abbad

23. Sounds of silence - Phonological awareness and written language in children with and without speech
Janna Ferreira

24. Postponed Plans: Prospective Memory and Intellectual Disability
Anna Levén

25. Consequences of brain tumours from the perspective of the patients and of their next of kin
Tanja Edvardsson

26. Impact on participation and service for persons with deafblindness
Kerstin Möller

27. Approaches to Audiological Rehabilitation with Hearing Aids: studies on prefitting strategies and assessment of outcomes
Marie Öberg
28. Social Interaction and Participation in Activities of Everyday Life Among Persons with Schizophrenia
   Maria Yilmaz
   Licentiate Degree, 2009

29. Focus on Chronic Disease through Different Lenses of Expertise
   Towards Implementation of Patient-Focused Decision Support Preventing Disability:
   The example of Early Rheumatoid Arthritis
   Örjan Dahlström

30. Children with Cochlear Implants: Cognition and Reading Ability
   Malin Wass

31. Restricted participation:
   Unaccompanied children in interpreter-mediated asylum hearings in Sweden
   Olga Keselman

32. Deaf people and labour market in Sweden.
   Education – Employment – Economy.
   Emelie Rydberg

33. Social rättvisa i inkluderande idrottsundervisning
   för elever med rörlighetsnödvändigheter – en utopi?
   Kajsa Jerlinder
   ISBN: 978-91-7668-726-0, 2010

34. Erfarenheter av rehabiliteringsprocessen mot ett arbetsliv
   – brukarens och de professionellas perspektiv
   Helene Hillborg

35. Knowing me, knowing you – Mentalization abilities of children who use
   augmentative and alternative communication
   Annette Sundqvist
36. **Lärare, socialsekreterare och barn som far illa – om sociala representationer och interprofessionell samverkan.**
   Per Germundsson

37. **Fats in Mind**
   Effects of Omega-3 Fatty Acids on Cognition and Behaviour in Childhood
   Ulrika Birberg Thornberg

38. **"Jobbet är kommunikation”**
   Om användning av arbetshjälpmedel för personer med hörselnedsättning
   Sif Bjarnason
   ISBN:, 2011

39. **Applying the ICF-CY to identify everyday life situations of children and youth with disabilities**
   Margareta Adolfsson

40. **Tinnitus – an acceptance-based approach**
   Vendela Zetterqvist

41. **Applicability of the ICF-CY to describe functioning and environment of children with disabilities**
   Nina Klang

42. **Bringing more to participation**
   Participation in school activities of persons with Disability within the framework of the International Classification of Functioning, Disability and Health for Children and Youth (ICF-CY)
   Gregor Maxwell

43. **From Eye to Us.**
   Prerequisites for and levels of participation in mainstream school of persons with Autism Spectrum Conditions
   Marita Falkmer
44. **Otosclerosis, clinical long-term perspectives**

Ylva Dahlin-Redfors