ACT Treatment of Epilepsy

Time for a behavioral model?

TOBIAS LUNDGREN
Abstract

The present dissertation contributes to the understanding of behavioral treatment of epilepsy and supports the integration of medical and behavioral science to develop a treatment model to help those who suffer from drug refractory epilepsy. There is a lack of well-designed randomized controlled trials evaluating behavioral therapy for epilepsy. Medical science has contributed significantly to the development of antiepileptic drugs for seizure control, yet despite these efforts approximately 1/3 of patients suffer from recurrent seizures. The comorbidity between epilepsy and psychiatric problems is significant and quality of life is lower for those who suffer from epilepsy compared to those who suffer from other chronic illnesses. The purpose of the present dissertation is to develop and evaluate a behavioral treatment model for those who suffer from recurrent epileptic seizures and associated problems. Acceptance and commitment therapy (ACT) is compared to supportive treatment and yoga. Outcome variables are seizure frequency, seizure index (frequency * duration) and quality of life. The dissertation consists of three studies; two studies with randomized controlled group designs to evaluate treatment effects and one mediational analysis study evaluating the effect of specific therapeutic processes. The mediational analysis examines specific ACT processes such as value attainment, epilepsy related psychological flexibility and persistency in overcoming barriers. The results of the two randomized controlled trials show a significant decrease in seizure frequency and seizure index in favor of the ACT group compared to the control groups and significant changes in life quality. The results of the mediational study indicate that the evaluated processes, alone or in combination, had a mediational role in three of the four outcome variables. In conclusion, the present dissertation supports the integration of behavior and medical science to help those who suffer from epilepsy and associated problems.

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I dedicate this dissertation to all my co-workers and friends in India, South Africa, and Sweden as well as to my dear cousin Martin. YNWA
List of Papers

The present doctoral thesis is based on the following studies:


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Introduction

Epilepsy, prevalence, predicaments

Epilepsy is a chronic neurological disorder characterized by recurrent unprovoked seizures. It affects about 1% of the population with complex effects on social, vocational and psychological functioning and cannot solely be cured by medication (Cull & Goldstein, 1997; Swinkels, Kuyk, Van Dyk, & Spinhoven, 2005). Anyone can experience an epileptic seizure and approximately 90% of any population will do so in their lifetime. Epileptic activity is normal and not necessarily pathological (Engel, 1989).

Persons suffering from epilepsy often have a lower quality of life compared to those who suffer from other chronic diseases, and the suicide rate is significantly higher (Johnson, Jones, Seidenberg, & Hermann, 2004; Tomson, Beghi, Sundqvist, & Johannessen, 2004). The comorbidity between epilepsy and psychiatric disorders such as depression and anxiety is high (Trimble & Van Elst, 2003; Kanner, 2011). Furthermore, the stigmatization for those with epilepsy is well documented and adds to the predicament of suffering from the condition (Macleod & Austin, 2003).

Of those who suffer from epilepsy, approximately 60-70% are successfully treated with antiepileptic drugs (AED) (Kwan & Brodie, 2000). Drug treatment is the treatment of choice for epilepsy. However, all of the antiepileptic drugs available today have documented side effects. Commonly described side effects are nausea, memory loss, dizziness and problems with salivation (Wallace & Farell, 2004; Zaccara, Gangemi, & Cincotta, 2008). AED causes disruption in learning, emotion, and cognitive development, (Reijs, Aldenkamp, & De Crom, 2004; Tomson, et al 2004) and although there is no doubt that AED has helped to reduce seizures, approximately 1/3 of patients still suffer from recurrent seizures despite medication.

An epileptic seizure is influenced by numerous internal and external factors (Wallace & Farrell, 2004; Dahl, 1992). Neurophysiological and medical science has contributed to the understanding of how nerve cells generate paroxysmal activity that can elicit epileptic seizures (Wolf, 2005; Wolf, 1995). Behavior science has contributed to an understanding of how behavior itself can influence seizure activity (Dahl, 1992; Martinovic, Simonovi,
The aim of this dissertation is to develop and evaluate a treatment model for epilepsy that integrates medical and behavioral knowledge to best help those who suffer from recurrent seizures and associated problems.

The medical model

The medical model is the dominant treatment paradigm for epilepsy and defines seizures as the behavioral manifestation of an underlying biological dysfunction. This organic dysfunction is usually attributed to a problem with inhibition and exhibition of electrical activity. Furthermore, the physiological cause of epilepsy (the abnormal brain discharges) is often unclear but could be attributed to either genetic causes or brain damage (Berg, Berkovic, & Brodie, 2010). One-way causation between pathology and symptom is assumed. The medical model gives little or no consideration to environmental, triggering and maintenance factors (Wolf, 2005; Montgomery & Epsie, 1986). A person is diagnosed with epilepsy if he or she has had at least two unprovoked seizures due to abnormal, repetitive, simultaneous discharges in the brain (Berg, Berkovic, & Brodie, 2010). Epileptic seizures were first classified as grand mal, petit mal or hysteroid seizures by the British neurologist Sir William Gowers (Gowers, 1886). Seizure types are now classified as generalized or focal, with subgroups such as tonic, clonic, myoclonic or absences. All seizures develop over time. On the one hand, generalized seizures have a shorter fuse while, on the other, focal seizures have a longer fuse. The longer the time between the first signs of epileptogenic activity and the full-blown seizure, the greater the amenability for conditioning (Berg, Berkovic, & Brodie, 2010).

The treatment of choice for epilepsy is antiepileptic drugs, which reduce nerve cell reactivity. This generally lowers the spread of paroxysmal activity, which is assumed to reduce the probability of seizure occurrence. Today, researchers recognize this model as too simplistic, as it fails to take the complexity of humans into account (Kanner, 2011; Elger & Schmidt, 2008; Wolf, 2005; Martinovic, Simonovi, & Djoki, 2006; Mittan, 2009). The reduction of nerve cell reactivity lowers brain activity in general, which affects the brain’s own ability to correct the imbalance in cortical activity (Birbauer, Lutzenberg, & Rockstroh, 1992). The natural way that the brain corrects itself is through an increase in cortical activity, which is assumed to block the spread of dysfunctional signals (Lockard & Ward, 1980). There is a probability that the drug treatment counteracts the brain’s natural synchronization process.
The behavioral model of epilepsy

Behavioral treatment of epilepsy has been studied for more than half a century and is based on a different model than the medical (Eriksson, 1940; Forster, 1977; Rockstroh, Birbaumer, Elbert & Lutsenberger, 1984; Cull & Goldstein, 1997; Fried, Rubin, Carton & Fox, 1984). The behavioral model assumes that there is no simple one-way cause and effect relationship between neuronal activity and seizure behavior (Birbaumer, Lutzenberg, & Rockstroh, 1992; Lindsay & Baty, 1986). From a behavioral perspective, seizures are seen as a complex interaction between a biological predisposition to seize and environmental factors (Lockard & Ward, 1980; Rosseau, Hermann, & Whitman, 1985). All persons have an individual biological predisposition to develop seizures (Engel, 1989). An epileptic seizure develops into a full-blown seizure due to internal and external factors including a biological predisposition, situational factors, operant and respondent conditioning. (Wolf, 2005; Dahl, 1992). In the traditional behavioral model of epilepsy, seizures are seen as a behavior just like any other behavior, entirely determined by the same learning mechanisms (Dahl, Melin, Brorson, & Schollin, 1985; Tan & Bruni, 1986).

Just as a panic attack is a physiological event influenced by psychological factors, it appears that seizures are, at least for some patients, triggered or inhibited by cognitive and emotional factors (Wolf, 2005). Beyenburg and colleagues (2005) suggest that there are common pathophysiological mechanisms between anxiety attacks and epileptic seizures. This assumption is based on the observation that epileptic activity in certain areas of the brain seems to be a direct cause of anxiety, usually in the form of panic (Trimble & Van Elst, 2003). The amygdala appears to be a particularly important area for the production of both anxiety symptoms and epileptic discharges (Beyenburg et al., 2005). Furthermore, Kanner (2011) suggests a bidirectional relationship between depression and epilepsy. Epilepsy does not only seem to influence depression; depression also seems to affect epilepsy. Persons suffering from depression have a three to seven fold higher risk of developing epilepsy (Forsgren & Nyström, 1999). A common pathophysiological model for epilepsy and depression similar to that for anxiety disorders and epilepsy has been suggested (Kanner, 2009). Behavioral and cognitive treatments have been found to be effective in the treatment of anxiety and depression (Olatunji, Cisler, & Deacon, 2010; Dimidjian, Hollon, & Dobson et al., 2006) and the development of a behavior model for epilepsy may increase the likelihood of understanding and successfully treating, recurrent seizures and comorbid problems.
Does behavioral treatment for epilepsy work?

Gowers (1886) published a series of cases in which he demonstrated that seizures could be influenced and aborted using behavioral techniques. In the late 1970s, Mostofsky and Balaschak (1977) reviewed 60 studies. Kraft and Poling (1982) reviewed studies between 1960-1980, while Goldstein (1990) reviewed studies published between 1980 and 1990. Recently the Cochrane library reviewed psychological treatment of epilepsy (Ramaratnam, Baker, & Goldstein, 2008). In the Cochrane review, many of the publications report good results but are criticized for low scientific quality and thus behavior treatment could not be recommended as an alternative treatment for epilepsy. The authors concluded that more research is needed.

In the recent review by Mittan (2009), fifteen psychosocial programs for epilepsy were reviewed. Outcome variables such as; seizure control, depression associated with epilepsy and quality of life, were evaluated. Six of the fifteen programs measured the effects on seizure frequency, of which five showed significant seizure reduction after treatment. In one of the behavior programs (Tieffenberg, Wood, Alonso, Tossutti, Vicente, 2000), 350 children were trained to assume a leading role in handling their health and their parents were trained to be facilitators. In separate groups, children and their parents were trained to identify risk situations for seizures, early triggers of seizure development, and different coping strategies to prevent and abort seizures. The outcome of this randomized controlled trail showed a significant reduction in seizure frequency and depression after treatment and at one year follow up. Similar effects have been reported in previous research not included in the Mittan review (2009). For example, Dahl and colleagues (1985; 1987) reported a significant reduction in seizure frequency and duration for both children and adults compared to a treatment control. Two programs reviewed in Mittan (2009) included clinically depressed clients and in both studies all participants were successfully treated and did not meet the criteria for depression after treatment and at the one year follow up. Eight of the programs evaluated quality of life as an outcome variable and five showed a significant improvement. Mittan (2009) concludes that even though more research is necessary, every modern epilepsy clinic needs to include a psychosocial perspective in their treatment programs for epilepsy.

Traditional behavioral therapy for epilepsy

Traditional behavior therapy for epilepsy aims to 1) predict a seizure response by discriminating intrinsic and extrinsic factors associated with seizure onset, (2) prevent seizure occurrence by encouraging clients to engage in activities previously avoided due to fear of seizures, (3) interrupt an ongoing seizure by means of increasing or decreasing activity or stimulation (vis-
ual, tactile, sensory, olfactory, gustation), and (4) alter the function of the seizure by encouraging alternative behaviors fulfilling similar functions (attention seeking, withdrawal of demands, physical contact, etc) (Dahl, 1992). The goal of traditional behavior therapy for epilepsy is symptom reduction, with specific focus on seizure decrease.

Traditional behavioral psychology suggests that thoughts and cognitions function in the same way as other behavior (Skinner, 1957). Early behavior therapy for epilepsy did not work with thoughts in any specific way (Dahl et al., 1985). Thought patterns were discussed but no specific interventions targeted thoughts or the process of thinking (Dahl, Melin, & Lund, 1987). Integrating traditional behavior therapy with recent knowledge about thoughts and cognitions would affect the treatment design for those who suffer from epilepsy and associated problems.

Traditional behavior therapy has been found to influence the seizure processes but we know little about its effectiveness regarding problems associated with epilepsy. Traditional behavior therapy does not have a specific focus on the overall predicament of suffering from epilepsy (Dahl, Melin & Brorson et al., 1985; Dahl, Melin, & Leissner, 1988). In an advanced behavior model for epilepsy, the overall predicament should be evaluated and treatment designed to target it. Regardless of the effects on seizure development, a focus on the overall predicament may be important for increasing quality of life. Furthermore, we do not know what the mechanisms of change are in a behavior therapeutic intervention for those who suffer from epilepsy and related problems. Understanding the mechanisms of change may increase the likelihood of developing therapies that target the specific processes responsible for therapeutic change and not only symptom reduction.

Below is a description of the traditional behavior model for epilepsy. It describes how thoughts, emotions, situational triggers, biological predisposition and the consequences of seizures interact and set the scene for seizure occurrence.
The phenomenon of an epileptic seizure is, according to the traditional behavior model, the result of an interaction between the predisposition of a low seizure threshold and internal and external triggers and consequences. Thoughts, emotions, biological predisposition and other situational triggers affect seizure probability as well as the consequences of seizures. Treatment focuses on generating antiepileptic behavior. A seizure develops over time and countermeasures are designed to stop or abort ongoing seizures before they develop into full-blown seizures.

The contributions of ACT to the treatment of epilepsy

Acceptance and Commitment Therapy (ACT) as a treatment approach will be discussed in more depth later in the dissertation but some of the main contributions of ACT to the treatment of epilepsy are highlighted below. ACT is the treatment approach for epilepsy developed and evaluated in this dissertation, taking previous research findings regarding behavior treatment of epilepsy into account and integrating countermeasures into an ACT frame to develop a model that considers the overall predicament associated with epilepsy as well as influencing seizures.

ACT is a value-based therapy, which means that a successful therapy helps the client to connect with important life directions as well as to take actions in those life directions. The main goals of ACT treatment for epilepsy is to create psychological flexibility, broaden the behavior repertoire and stimulate actions in important areas of life. Symptom decrease is not the overall goal as it is in a more traditional behavior treatment for epilepsy. In ACT therapy, the client and the therapist define therapeutic values and goals to-
gether. This is important for many reasons, such as; enhanced quality of life, activation in the face of emotional difficulties, motivation to go through therapy, and to target the overall predicament of having epilepsy.

ACT is built on traditional behavior theory constructs such as operant and respondent conditioning but adds recent knowledge about human thinking (Hayes, Barnes-Holmes & Roche, 2001). The developed theory of human thinking (RFT) on which ACT is based will be discussed in more depth later. Taking more recent knowledge of human thinking into consideration affects both the analysis and the treatment of epilepsy. Clients suffering from epilepsy often avoid things not only due to their epilepsy but also due to their thoughts and feelings associated with epilepsy. ACT aims to decrease the negative effect of these associations and increase the positive effect of our ability to think in abstract terms (Hayes, Strohsal & Wilson, 1999).

In an ACT model, treatment processes are designed to affect the context through which specific problematic behavior patterns arise, not only the problematic behaviors directly. These problematic behavior patterns involve seizure eliciting patterns, rumination patterns, worrying patterns, anxiety patterns, etc. Inflexible and rigid behavior patterns are targeted in order to help clients build a flexible and more effective behavior repertoire.

The treatment strategies in an ACT model for epilepsy are; 1) predict a seizure response by discriminating intrinsic and extrinsic factors associated with seizure onset, 2) prevent seizure occurrence by encouraging the client to engage in valued activities generally and specifically those previously avoided due to seizures, 3) prevent and/or interrupt seizure occurrence or an ongoing seizure by disrupting the effects of problematic cognitions, 4) prevent and/or interrupt seizure occurrence or an ongoing seizure by targeting experiential avoidance, 5) prevent and/or interrupt seizure occurrence or an ongoing seizure by increasing or decreasing activity or stimulation, and 6) alter the function of the seizure by encouraging alternative behaviors fulfilling similar functions.

Below is an ACT model for the development of seizures and problematic behavior patterns. All of the variables in the outer boxes are contextual variables that affect the probability of seizure occurrence. Together they set the scene for all behaviors such as seizures, rumination and other problematic behaviors.
According to an ACT model, the phenomenon of an epileptic seizure is the result of context. A new context is generated at any given moment. The focus of treatment is to change the context through ACT processes combined with seizure management techniques from traditional behavior therapy. Changing the context around seizures and other problematic behaviors is hypothesized to affect seizure triggers, maintenance factors and create psychological flexibility. A more thorough description of ACT, its treatment approach for epilepsy and its theoretical underpinnings is presented below.

**Acceptance and Commitment Therapy (ACT)**

ACT is a behavior treatment approach developed within the behavior analytic science tradition and not a set of specific techniques or interventions (Hayes, Strohsal & Wilson, 1999). Functional contextualism (FC) is the philosophical foundation of ACT (Hayes, 1993). Its theoretical underpinnings are operant and respondent conditioning as well as relational frame theory (RFT) (Hayes, Barnes-Holmes, & Roche, 2001). ACT aims to build a psychology that predicts and influences human behavior with precision, depth and scope in order to more adequately meet the demands of human suffering. Following the behavioral tradition, ACT aspires to maintain a close relationship between basic research and clinical intervention (Hayes, 1993). Hayes and colleagues published the first clinical study on ACT in 1986 (Zettle & Hayes). Since then, ACT has been tested with success in many different psychiatric disorders such as depression, anxiety, post-trau-
matic stress disorder, and drug abuse (Hayes et al. 2006). Furthermore, ACT has been tested as a treatment approach for medical conditions such as chronic pain and diabetes (Dahl, Wilson, & Nilsson 2004; Gregg, Callaghan, & Hayes et al., 2007) with good results. ACT is now listed as an empirically supported treatment for chronic pain and depression (APA, 2006/2011). Epilepsy treatment built on ACT aims to incorporate all available psychological knowledge that has an effect on the development of epileptic seizures. The intention behind ACT clinical work is to create psychological flexibility around private events that trigger rigid, unhealthy behavior patterns in order to enable vital and effective ones.

**ACT as a treatment approach**

A brief description of ACT’s clinical approach is; *open up, be present and get moving*. *Open up* refers to the process of accepting, defusing and becoming aware of thoughts, emotions and sensations evoked in specific situations. These private events are, in part, a result of the individual’s learning history and often verbally derived. A person may not react to the outer reality but instead to associations derived from similar situations. *Being present* refers to the process of making the person aware of what is noticed from moment to moment both inside and in the outer reality. For example, becoming aware of where she is, what is seen, sensed, heard, thoughts that occur, and emotions that emerge. Instead of just reacting to thoughts, the client can hone his or her ability to notice reactions and urges to act in specific ways and instead choose effective actions in accordance with the demands of the situation. *Get moving* refers to the process of making contact with what is important in specific situations, notice emerging experiences moment to moment and choose to act according to chosen values.

ACT is not a therapeutic model that first and foremost attempts to reduce problematic thoughts, emotions, or sensations. Instead, the primary goal is to create psychological flexibility and help clients to choose their actions from a reference of effectiveness. Effective actions help the client to proceed in directions he or she considers important despite emotional and cognitive barriers. They are defined by workability and not by topography (Wilson & Murell, 2004; Dahl, Plumb, Stewart, & Lundgren 2009). ACT suggests that experiential avoidance (EA) is one of the roots of psychopathology (Hayes, Strosahl & Wilson, 1999; Hayes, Strosahl, & Wilson et al., 2004). Experiential avoidance refers to verbal human beings’ tendencies to not only avoid dangerous situations or events, but also thoughts and feelings associated with them (Williams & Lynn, 2010). ACT aims to create flexibility around these private events in order to make new experiences possible. Instead of reducing private events, the goal of ACT is to develop a broader and more flexible behavior repertoire.
ACT strives to facilitate psychological flexibility through six core processes; acceptance, defusion, mindfulness, self as context, values, and committed action (Blackledge & Barnes-Holmes, 2009). In the studies included in this dissertation these processes have been adapted to create flexibility around the epileptic experience and challenging life situations. Creating flexibility around seizure experiences and stimulating valued actions may develop a broader behavior repertoire in important areas of life. The following is a description of the six core processes of ACT.

**Acceptance:** is a behavioral alternative to experiential avoidance. In ACT, acceptance means willingly contacting emotions and sensations that have previously been avoided, without trying to change their frequency or form. Acceptance is not construed as an end in itself but rather as a method of increasing flexible values-based actions (Hayes, 1994).

**Defusion:** refers to the process of changing the function of thoughts. ACT does not attempt to directly change the topography of thoughts but instead trains clients to notice thoughts as they are and not as they say they are. This is hypothesized to change the negative effects that the thought process may have on outer behavior. The opposite of defusion is fusion. Fusion means being stuck in a thought pattern that leads to a non-effective, rigid and inflexible behavior repertoire (Blackledge, 2007).

**Self as context:** ACT and RFT state that perspective taking is possible through the human ability of relational framing. This in turn facilitates empathy and theory of mind (Hayes, 2004). From the self as context perspective, verbal human beings can become aware of the flow of experiences without treating them as truths. Retaining experiences such as thoughts, emotions, and sensations lightly aims at facilitating psychological flexibility and increasing the likelihood of effective value-based actions (Blackledge, 2003).

**Present moment:** ACT promotes an ongoing non-judgmental stance toward experiences and the world. An ACT therapist helps the client connect with the world and situations more directly, in order to get in touch with what matters in life. The opposite of avoiding experiences is to willingly contact them in a non-judgmental manner. This is, together with acceptance and defusion work, fostered through mindfulness processes (Hayes & Wilson, 2003).

**Values:** are defined as “Freely chosen, verbally constructed consequences of ongoing, dynamic, evolving patterns of activity, which establish predominant reinforcers for that activity that are intrinsic in engagement in the valued behavioral pattern itself” (Wilson & Murell, 2004). Through values
work, the therapist helps clients to contact what really matters to them in life; what they consider important and what they want their life to be about. Values serve to stimulate alternative directions for behavior, driven by what the person considers important and meaningful, instead of experiential avoidance (Dahl et al., 2009).

**Committed action:** refers to actions taken in valued directions. Committed actions are steps taken moment by moment, together with all the experiences that may arise during life, that lead in directions that are meaningful (Hayes, & Strohsal, 2005).

Through these six core processes, psychological flexibility is fostered and valued actions are stimulated. The overall goal of psychological flexibility is to reduce experiential avoidance and help clients live a life that they consider meaningful. Clients who are stuck in fear of future possible events or unbearable emotions act in and through that context. ACT aims to create flexibility around negative thought patterns and emotions in order to make room for actions based on the present moment and what is important for that individual.

ACT is based on operant and classical conditioning and on a theory of language and cognition, RFT. Traditional behavior therapy relied on classical and operant conditioning and hypothesized that thought and cognitions functioned in the same way as observable behavior. ACT and RFT researchers hypothesize that thoughts and cognitions have certain characteristics that differentiate how our thinking develops from the development of other behavior. ACT clinicians aim to maintain the link between basic research and clinical work as tight as possible. Below is a description of RFT.

**Relational Frame Theory and epileptic seizures**

The traditional behavioral model describes how epileptic seizures can be brought about through processes of respondent and operant conditioning. Thus, epileptic seizures are hypothesized to be under the control of respondent and classical conditioning mechanisms (Wolf, 2005; Dahl, 1992). However, a relatively new behavioral approach toward language and cognition, Relational Frame Theory (RFT) (Hayes, Barnes-Holmes, & Roche, 2001), explains human language as a type of generalized operant response referred to as arbitrarily applicable relational responding (or relational framing). This unique human capacity may be important in understanding seizure elicitation and maintenance.

Traditional behavioral psychology suggested that thoughts and cognitions function in the same way as other behavior (Skinner, 1957). However, RFT
suggests that thoughts and cognitions have certain specific characteristics that differ from other behavior. According to traditional behavior and cognitive models (Beck, 1993; Lange, 1985; Skinner, 1938/1991), humans learn through direct experiences. However, the traditional cognitive and behavior models often implicitly and explicitly suggest relations between stimuli, which cannot be explained by other theoretical approaches such as information processing theory, stimulus generalization, operant or respondent conditioning (Blackledge, 2003). The understanding of how humans relate stimuli is the cornerstone of RFT (Hayes et al., 2001).

Relational frame theory argues that through exposure to the socio-verbal community humans learn to relate things in their environment, including words, objects, and events, in various ways (e.g., same, opposite, different etc.). These learned relations are not based on the physical characteristics of the things but on the presence of contextual cues that signal the appropriate relation. For example, according to RFT, people learn to relate particular words as being the same as particular objects, in the presence of the contextual cue ‘name of’. This is an example of the relational frame of ‘coordination’ or sameness. We learn many other patterns of generalized relational responding (e.g., ‘opposition’, ‘distinction’, ‘comparison’). Together, these relational framing responses become part of an increasingly powerful and flexible verbal repertoire.

This learned behavior is referred to as arbitrarily applicable relational responding or relational framing and is characterized by three properties: mutual entailment, combinatorial entailment and transformation of function. Relating stimuli is done through mutual and combinatorial entailment. Mutual entailment refers to the bidirectional relationship between two stimuli. Any unidirectional relation from stimulus A to stimulus B (e.g., ‘A is larger than B’) always entails another unidirectional relation from B to A (in this example, ‘B is smaller than A’). Combinatorial entailment refers to the combination of relations giving rise to further relations. For example, if ‘A is larger than B’ and ‘B is larger than C’ then ‘A is larger than C’ and ‘C is smaller than A’ (Blackledge, 2007). The third property is transformation of stimulus functions, which refers to the fact that the psychological functions of a stimulus in a relational frame can be changed or transformed in accordance with the psychological functions of the other stimuli to which it is related and the type of relations involved (Dymond & Rehfeldt, 2000; Hayes, Fox, & Gifford et al 2001; Dymond & Rehfeldt, 2000; Dymond, Roche, Forsyth, Whelan, & Rhoden, 2007; 2008).

Through the phenomenon of transformation of stimulus functions, the psychological functions of stimuli in both the inner and the outer environment can change rapidly and without direct conditioning. This process is particu-
larly relevant in explaining the effects of human language in relation to epilepsy. For example, imagine that there is a bi-directional relationship of sameness between seizures and emotions such as fear and shame, since having a seizure can produce such emotions and the presence of such emotions has the potential to increase the likelihood of seizure. RFT would argue that relational framing and transformation of function are likely to play an important role in linking the two phenomena and exacerbating the problem, since the person probably explicitly relates them in language (e.g., through thoughts such as ‘I hate and fear seizures – they make me so ashamed’). The functions of, for example, hate can easily transfer to the shame so that the presence of these emotions for reasons other than seizure can prime thoughts of seizure and make seizure behavior more likely to occur. In addition, through multiple learning experiences, relations may be established between seizures and particular places and events (e.g., ‘I had a seizure before in a place similar to this shop’), and functions of fear and shame as well as seizure elicitation may transfer to those places. Such functions may even transfer to other places that may not be physically similar to the place in which the seizure happened but that can be considered similar in a more abstract way. For example, a large shopping mall may be physically dissimilar to a small corner store but they are easily related in language since they are both ‘shops’. Hence the functions of fear, shame, and seizure elicitation may transfer to the shopping mall even though it appears dissimilar.

RFT theoretical conceptualizations such as the above have the potential to increase our knowledge of, and shed new light on, the development and maintenance of epileptic seizures. Furthermore, RFT conceptualizations suggests some clinical implications for cognitive and behavior therapy due to the specific characteristics of language and cognitions that might merit further attention.

Case example
To illustrate ACT treatment, a treatment plan is outlined below based on the results of the analysis. The behavior analysis is briefly described. The treatment plan is for a fictive person called Maria who suffers from recurrent seizures despite medication. No outcome data or result section will be presented.

Analysis
The goal of behavior analysis is prediction and control of behavior with precision, scope, and depth (Hayes, Hayes, & Reese, 1988). ACT is within the behavior analysis field and applies the same goals. The therapist uses infor-
formation from the analysis to create hypotheses about how seizures and other problematic behaviors are triggered and how seizure development can be influenced and eliminated. As described earlier in this dissertation, seizures are considered behaviors and thus carefully analyzed in a behavior analysis. An assumption in the behavioral model is that seizure behavior follows the same respondent and operant conditioning mechanisms as other behavior. The process of thinking and how relational framing may affect behavior is also considered. Defining seizures as behavior implies that they can be influenced by environmental changes. Maria’s seizure triggers and maintenance factors were carefully analyzed. Seizure triggers are factors that elicit seizure development. Seizure maintenance factors are reinforcing consequences of seizure behavior.

An epileptic seizure follows a chain of events. This chain of events is analyzed and high-risk and low-risk situations for seizure development are highlighted in the contextual behavior analysis. High-risk situations are those in which Maria often develops seizures. A tailor-made treatment plan is developed from the information in the behavior analysis.

**Intervention**

Maria and her therapist defined treatment goals based on the information in the analysis. The overall goal was to influence the seizure chain, reduce the frequency and duration of seizures and increase quality of life. The therapist and client created hypotheses about how to influence the seizure chain and create a more meaningful life. The treatment principles included teaching Maria to: 1) predict a seizure response by discriminating intrinsic and extrinsic factors associated with seizure onset, 2) prevent seizure occurrence by encouraging Maria to engage in valued activities in general and specifically those previously avoided due to seizures, 3) prevent and/or interrupt seizure occurrence or an ongoing seizure by disrupting the effects of problematic cognitions, 4) prevent and/or interrupt seizure occurrence or an ongoing seizure by targeting experiential avoidance, 5) prevent and/or interrupt seizure occurrence or an ongoing seizure by increasing or decreasing activity or stimulation, and 6) alter the function of the seizure by encouraging alternative behaviors fulfilling similar functions. Below is a description of Maria’s treatment structure.
Table 1 presents the content and structure of Maria’s treatment. Session time = 1.5 hours. The therapist can address all of the treatment components at every session but with a focus on a specific topic/topics. An X in the box indicates a specific focus on that particular component. The time between sessions is one week.

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<tr>
<th>Session content</th>
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Treatment components

All treatment components are intended to fulfill the treatment goals, namely to reduce seizure frequency and increase quality of life. The division between countermeasures, acceptance, defusion, and so forth is mainly pedagogical. Acceptance, defusion, values, and mindfulness are all potential countermeasures. Countermeasures are both functional and intentional. If the treatment components influence the seizure frequency and duration, they function as countermeasures. Below is a description of all treatment components, why they were chosen, how they are hypothesized to work, and the targeted treatment principles.

**Mindfulness**

_Treatment principles 2, 3, and 6 are specifically targeted_  
Maria stated that she often thought about possible future seizures and past situations when she had experienced seizures. She said that her worry about her life situation and her epilepsy increased before seizures. Directly after seizures she did not ruminate and her mind felt clear. When she felt balanced, in harmony and clear in her mind she rarely developed a seizure. Mindfulness aimed at helping Maria to contact the present moment and experiences in order to increase her sense of harmony and balance, thus reducing the likelihood of seizures. Mindfulness aims to create a pause between trigger and action. By creating a space between trigger/reaction and action, the circle leading up to a seizure may be prevented and aborted. Mindfulness work was intended to enhance Maria’s ability to choose effective behaviors in accordance with the demands of specific situations. Mindfulness has been shown to reduce stress in persons suffering from epilepsy (Panjwani, Gupta,
Singh, Selvamurthy, & Rai, 1996) and has been part of protocols demonstrating beneficial effects for other medical and psychiatric disorders (Hayes et al., 2006). Furthermore, Blackledge & Barnes-Holmes (2009) state that practicing acceptance, defusion, and values work in the moment enhances the effect of these interventions.

**Exposure**

*Treatment principles 1, 2, 4 and 6 are specifically targeted*

The purpose of exposure was to transform stimulus functions that triggered seizures and alter the function of seizures by encouraging alternative behaviors fulfilling the same functions. Exposure techniques are used effectively in treatment for many different disorders including anxiety, obsessive-compulsive disorders (Abramowitz, 1996; McMillan & Lee, 2010), and pain (Dahl, Wilson, & Nilsson, 2004). The analysis revealed that Maria avoids situations and private events leading up to seizures. In order to break the vicious circle Maria was taught to act differently in situations where epilepsy associations were present. Exposure was conducted both during the sessions and as homework assignments. During the sessions, imaginary procedures were used to simulate seizure related experiences without eliciting the full-blown seizure. Maria was instructed to fully experience her seizure triggers without defense with the intent of changing their stimulus functions. In ACT treatment, exposure is not primarily used to decrease symptoms but to increase the possibility of valued choices (Hayes, Strohsal, & Wilson, 1999).

**Acceptance**

*Treatment principles 2 and 4 are specifically targeted*

Maria said that she avoided not only thoughts related to epilepsy but also emotions associated with epilepsy. The short-term consequence of Maria’s avoidance behavior was often anxiety reduction. The long-term consequence of this vicious circle of avoidance was that her everyday life became more restricted, quality of life decreased, anxiety increased, and seizure behavior was maintained. Karekla, Forsythe, and Kelly (2004) claim that experiential avoidance is a core psychological process underlying the development and maintenance of psychopathology. Experiential acceptance is the opposite of experiential avoidance (Blackledge & Hayes, 2001). Acceptance is an active approach and should not be considered to be passive resignation (Williams & Lynn, 2010). The aim of the acceptance work was to help Maria experience her emotions and fears as they are, without trying to change or avoid them in order to break vicious circles leading up to seizures, anxiety, and poor quality of life. Metaphors like the “bus metaphor” and exercises such as the “physicalization exercise”, “looking for mister discomfort” (Hayes, Strohsal, & Wilson 1999), and imaginary focus on feelings and experiences when thinking about seizure situations are used to facilitate acceptance.
Countermeasures
*Treatment principles 3, 4 and 5 are specifically targeted*
The purpose of countermeasures is to influence the behavior chain that leads up to a seizure and to abort ongoing seizures. Countermeasures have been shown to be effective for influencing seizures in both children and adults (Dahl, Melin & Brorson et al., 1985; Dahl, Melin, & Leissner, 1988; Betts, Fox, & MacCallum, 1995). A countermeasure is an intervention that affects the relationship between trigger – response and behavior – consequence. Changing these relations aims to change the context in which Maria’s seizures develop, thus decreasing the likelihood of seizure development. Maria’s analysis suggests that experiences related to her seizures trigger her to search for a place to have the seizure. Instead of searching for a place to have seizures, Maria was asked to be still and willingly and fully experience the sensations involved in her seizure development (acceptance and defusion contingent on the seizure chain). Being still and fully experiencing seizure related sensations were hypothesized to have the potential to be a countermeasure. Furthermore, Maria described that she felt clear in her mind after a seizure. She once had a similar experience after consuming a large chunk of fresh ginger when eating sushi. Maria was asked to carry fresh ginger and chew on it when she felt that a seizure was on the way. Chewing on fresh ginger contingent on seizure elicitation was considered to have the potential to influence seizure occurrence.

Defusion
*Treatment principles 2 and 3 are specifically targeted*
Maria described intrusive thoughts related to her epilepsy. These thoughts had stimulus functions contributing to evoking anxiety, stress and epileptic seizures. The aim of the defusion intervention was to help Maria disrupt the effects of problematic cognitions. By disrupting the effects of problematic cognitions, psychological flexibility can be developed and the probability of seizure occurrence influenced. Defusion has been used effectively in treatment programs for other psychiatric and medical conditions (Hayes et al., 2006), and the process of defusion has in itself proven successful in decreasing the negative effects of thoughts (Masuda, Hayes, & Sacket et al., 2004). Examples of defusion exercises used to fulfill the treatment goal are “kick your butts”, “leaves on a stream” and “take your mind for a walk” (Hayes, Strohsal, & Wilson 1999).

Values
*Treatment principles 2 and 6 are specifically targeted*
Maria had stopped doing things she liked and considered meaningful in order to avoid possible future seizures. Avoidance of experiences associated with epilepsy became a vicious circle in her life, leading to a reduced quality
of life. Paradoxically, less activity in rewarding life directions seemed to create vulnerability for seizure development. Encouraging Maria to be active in life directions that she considers meaningful could prevent seizures from occurring and change the reinforcing qualities of seizure behavior. Modern epilepsy treatment should support the client to exercise regularly and change as little as possible due to epilepsy or fear of seizures (Elger & Schmidt, 2008). Values work was intended to help her break the vicious circle and get in touch with what was really meaningful to her in life. Examples of exercises to identify values and stimulate actions in valued directions are the values compass (Wilson & Murell 2004; Dahl, Wilson, & Nilsson, 2004) and the Bull’s-Eye values survey (Lundgren et al., under review).

**Homework assignments**

*All treatment principles are targeted, depending on the session*

Changing and influencing a rigid behavior pattern takes time and practice. Homework assignments are seen as an important and necessary part of behavior treatment (Freeman, 2007). The homework assignments aimed to stimulate Maria to practice in her everyday life what she and her therapist had discussed during the session. Homework assignments were chosen based on the seizure diary and the treatment plan. Examples of homework assignments for Maria were structuring her exercise schedule, mindfulness training, challenging fears associated with epilepsy, working with valued action plans, and testing different countermeasures.

All of the intervention strategies are designed to fulfill the treatment goals defined by the client and the therapist. Although the treatment package has the potential to make a difference, it is difficult to draw conclusions about which specific components that most contributes to the outcome. Is it the exposure strategy, the homework, the defusion practice or is it a combination of all of the processes that make a difference? Greater understanding of the contribution of specific treatment processes to positive outcomes may help therapists to develop more precise treatments.

**Processes of change in psychotherapeutic treatment**

Psychotherapeutic intervention packages have been developed and evaluated for a range of different disorders with various and often interesting results (e.g. Beck, 1993; Abramowitz, 1996; Dimidjan et al., 2006). However, the mechanisms of change in those treatments have received little attention. There is an ongoing debate within the psychotherapeutic field on the subject of the actual mechanisms of change in psychotherapeutic interventions (Longmore & Worell, 2007; Hofmann & Asmundson, 2008). ACT hypothesizes that psychological flexibility, which is fostered through the six core
processes described earlier in the dissertation, is a main variable that affects outcome. Previous mediational analysis of ACT has evaluated defusion, acceptance, and committed action as mediators (Hayes et al., 2006). Research has shown that when traditional components of behavioral and cognitive therapies are compared with ACT components, the mechanisms of change support ACT hypothesis (e.g., Vowles, 2007; Forman, Hoffman et al., 2007). Evaluating mechanisms of change has the potential to increase our understanding of what components to emphasize in order to design effective treatment.

Aim of the dissertation

There is a lack of well-designed randomized controlled trials showing good results for the behavior model. However, some studies suggest that behavior treatment decreases the probability of seizure occurrence, increases quality of life and decreases depression in those who suffer from recurrent seizures. What the mechanisms of change are in the treatments with a positive outcome has not been identified. The aim of the present dissertation is to develop and evaluate a behavioral treatment model for those who suffer from recurrent epileptic seizures and associated problems. The first two studies presented in this dissertation aim to develop and evaluate a treatment model for epilepsy based on contextual behavior psychology. The purpose of the third study is to evaluate specific mechanisms of change in ACT treatment of epilepsy.

Research questions

What are the effects of ACT treatment combined with medication on seizure frequency and duration compared to an active control group for those who suffer from recurrent seizures?

What are the effects of ACT treatment combined with medication regarding quality of life compared to an active control group for those who suffer from recurrent seizures?

What are the mediational effects of ACT processes such as psychological flexibility, value attainment, and potency of barriers on seizure frequency and duration as well as quality of life in ACT treatment for epilepsy?
Empirical Studies

Study I:
Evaluation of acceptance and commitment therapy for drug refractory epilepsy: A randomized controlled trial in South Africa – a pilot study

Introduction
Persons suffering from epilepsy in developing countries face additional challenges besides psychiatric comorbidity and low quality of life. Medical and technical health care is expensive and therefore not available to the majority of the 45 million who suffer from epilepsy in developing countries. The ACT model for epilepsy is low cost, non-invasive and could, if effective, be an important complement to medical treatment. It is of the utmost importance to conduct well-designed, methodologically robust randomized controlled trials in order to evaluate the effect of behavior medicine treatment for those who suffer from recurrent seizures despite medication. The ACT model for epilepsy integrates medical treatment with knowledge from behavior research to influence not only the actual seizures, but also side effects of medications and quality of life problems (Dahl & Lundgren, 2005). In this study ACT and Supportive treatment were evaluated as a complement to medical treatment in a developing country.

Aim
The aim of this study is to develop and evaluate a behavior medicine model, based on ACT, for those who suffer from recurrent epileptic seizures despite medication.

Research questions
What are the effects of ACT treatment for epilepsy combined with medication on seizure frequency and seizure index compared to supportive treatment for those who suffer from recurrent seizures?
What are the effects of ACT treatment combined with medication for epilepsy regarding quality of life compared to supportive treatment for those who suffer from recurrent seizures?

Method

The method consisted of a randomized control group trial design with repeated measures (N=27). Participants were randomized into one of the two conditions: ACT or Supportive Treatment (ST). Inclusion criteria were: able and willing to participate in the study, at least four seizures during the previous three months, and an EEG verified epilepsy diagnosis. If medicinal changes were made during the study period, participants were offered the opportunity of continuing treatment, but were excluded from the study. However, there were no dropouts. All clients invited to participate in the study did so. Participants were aged between 21 and 55 years. Thirteen males and fourteen females were equally randomized into one of the two conditions. Four of the participants in the ACT group and five of the participants in the ST group needed help from an interpreter. Staff members at the center were given a half-day workshop in ACT in order to function as interpreters. The interpreters were instructed to only translate what the therapist said and not to add any other information during the assessment and treatment. Most of the participants were living in a center for epilepsy. Nurses at the center administered medication to the participants every morning and evening. The nurses administering the medication did not know whether participants were randomized into ACT or ST.

The treatment consisted of four sessions: one initial individual session, followed by two group sessions, and one final individual session. Booster sessions were provided after the 6-month and one-year follow up. Both groups received the same amount of time with the same therapists. Therapeutic effects were measured at the end of treatment, as well as at the six-month and one-year follow-up.

Measurements

To measure therapeutic effects, seizure index (frequency*duration) and quality of life (SWLS and WHOQOL-Bref) were used. Seizure data are presented as frequency and seizure index (index = frequency × duration in seconds). The Satisfaction With Life Scale (SWLS) is a self-report measure of global judgments of satisfaction with one’s life (Diener, Emmons, Larsen, & Griffin, 1985). The scale consists of five statements such as, “In most ways my life is close to ideal” and “I am satisfied with my life.” Responses are rated on a 7 point scale from 1 (strongly disagree) to 7 (strongly agree), with scale totals ranging from 5 to 35. The SWLS has shown a strong internal
reliability ($\alpha = .87$), good temporal stability (Diener, Emmons, Larsen, & Griffin, 1985) and is one of the primary well-being measures used in quality of life research. The World Health Organization Quality Of Life (WHO-QOL-BREF) is a widely used instrument with a reported Cronbach’s alpha of between 0.81–0.90. The instrument consists of four domains; psychological health, physiological health, social relationships, and environmental health. The participants rate their life quality on a scale from 1-5. The discriminant validity was satisfactory and the instrument did not show any ceiling or floor effects. (Amir, Marcelo, & Herrman, Lomachenkov, Lucas, Patrick, 2000).

Statistical analysis

The statistical analyses were performed using Statistica 6.0 (Statistica, 2002). To examine interaction and between-group effects, mixed ANOVA’S (two groups and four time periods) with repeated measurements were carried out. Cohen’s $d$ effect sizes were also calculated. The Tukey post-hoc test was performed to detect the position of changes and differences.

Results

The results of the study showed that participants in the ACT group significantly decreased their seizure index (duration * frequency of seizures) ($F (3,75) = 9.28 \ p < 0.001$) and frequency $F (3,72) = 26.79 \ p < 0.001$) compared to the supportive treatment (ST) control condition. Figure 3 shows the effects of ACT treatment for epilepsy compared with ST measured by seizure index. The effect sizes of seizure frequency measured by Cohen’s $d$ showed a large effect between groups over time in favor of the ACT group (post=.97, six-month=.92, one-year=.89). The effect sizes for seizure index were also large (post=1.45, six-month=1.20, and one-year=1.25). Tukey's post hoc test showed a significant between-group effect in favor of the ACT group at every comparison. No pretreatment differences were found.

Participants in the ACT group increased their quality of life significantly compared to the attention control group ($F (3,75) = 18.497 \ p < .001; F (3,75) = 9.739$). Quality of life was measured using Subjective Wellbeing Life Scale (SWLS) and World Health Organization Quality Of Life brief version (WHOQOL-BREF). Between-group effect sizes were large for both instruments. SWLS post effect size = 1.72, six-month = 2.29, one-year = 2.47. WHOQOL-BREF post = 0.37, six-month = 0.61, and one-year = 1.78. The Tukey post hoc test showed that differences were mainly due to higher ratings in the ACT group between post and six-month follow-up. No significant pretreatment differences were found.
Figure 3. Participants in the ACT group significantly reduced their seizure index following the intervention compared to the ST group. There were no significant changes in the ST group. The Intervention took place during the eighth and ninth month.

Discussion

The results of study I show significant interaction effects in all dependent measures in favor of the ACT group after treatment, at the six-month and one-year follow-up, compared to supportive treatment. Quality of life increased and seizure index and seizure frequency decreased significantly. The results suggest that persons suffering from drug refractory epilepsy may benefit from short term, behaviorally oriented treatment as a complement to medication. The hypothesis suggesting that ACT combined with medication may be a potent and effective treatment for those who suffer from recurrent seizures seems to be strengthened by this study, indicating that the ACT model needs further attention.

This study contributes to previous research in at least three ways. Firstly, according to the Cochrane review (2008), there is a lack of randomized controlled trials in psychological treatment of epilepsy. The design of this study is a randomized control group study. Secondly, the experimental condition entails a combination of ACT and traditional seizure technology that focuses on building a broader behavior repertoire in a valued direction. Finally, the study was conducted in a developing country. Much research published today is designed by and developed for persons in western countries. Epilepsy is a widespread problem and the majority of people in developing countries do not have access to state of the art medication. The result in this study indicates that ACT treatment for epilepsy could be provided despite lan-
guage and cultural barriers. For those who suffer from epilepsy and related problems, both in the western world and in developing countries, the development of a contextual behavioral treatment model is of the utmost importance.

There are methodological problems in the study that need attention. The number of participants is low, which should make it harder to detect differences. In the present study differences between groups were detected despite the fact that the number of participants was low, which makes the results even more interesting. In future research the inclusion of more clients would be beneficial for evaluation of the overall effectiveness of the intervention.

The ACT model combined with traditional behavior technology includes intervention strategies developed both in the traditional behavior therapeutic model and in the ACT model. The variety of treatment strategies may make it difficult to differentiate the mechanisms of change in the treatment. Future research should present group as well as individual data. Well-designed experimental single subject studies could add to the understanding of the mechanisms of change. Furthermore, mediational analysis evaluating specific processes may increase knowledge of the contributions of specific processes on outcome. Understanding the processes of change may make it more likely to design effective treatments for those who suffer from recurrent seizures and poor quality of life.
Study II: 
Acceptance and commitment therapy and yoga for drug – refractory epilepsy: A randomized controlled trial

Introduction
Studies showing effects of behavior treatment on epilepsy exist, but due to the lack of good scientific control, the possibility of drawing conclusions is limited (Ramaratnam, Baker, Goldstein, 2008). In this study, ACT and Yoga, respectively, were combined with medication and tested for individuals who suffer from recurrent seizures in India.

Similar to biofeedback and relaxation training, Yoga may influence seizure occurrence due to its possible effect on brain wave activity and arousal (Yardi, 2001). Vagus nerve stimulation has been shown to decrease seizure frequency by 28-38% and Yoga may affect the vagus nerve (Brown & Gergab, 2005). Arousal and sudden changes in cortical activity have been shown to affect seizure frequency (Handforth, DeGiorgio, Schachter et al., 1998). Yoga, like biofeedback, may affect arousal and brain wave activity in such a way that seizure occurrence is influenced (Rockstroh et al., 1984).

Aim
The aim of this study is to test the effects of ACT and Yoga as complementary treatments to antiepileptic drugs for those who suffer from recurrent seizures.

Research questions
What are the effects of ACT treatment for epilepsy combined with medication on seizure index, seizure frequency, and duration compared to Yoga for those who suffer from recurrent seizures?

What are the effects of ACT treatment combined with medication for epilepsy regarding quality of life compared to Yoga for those who suffer from recurrent seizures?

Method
The study is a randomized controlled two-group design with repeated measures (N=18). Participants were randomized into one of two treatment conditions - ACT or Yoga. Inclusion criteria for participation in the study were: able and willing to participate in the treatment program, at least three seizures during the previous three months, and an EEG verified epilepsy diag-
nosis. Participants were excluded if any medicinal changes were made during the project period. Participants excluded from the study for medical reasons or medication changes were offered the opportunity to continue treatment, but their data were excluded from the statistical calculations. However, there were no dropouts and all of the invited clients participated. Patients ranged from 18 to 55 years and were recruited from an outpatient clinic. Six out of ten clients in the ACT group needed an interpreter. To ensure treatment integrity, staff members who helped with translation were given a half-day ACT for epilepsy workshop in order to help them understand the general treatment principles. The interpreters were instructed to only translate what the therapist said and not add any other information during the assessment and treatment. Two therapists experienced in ACT and behavioral treatment for epilepsy were responsible for the ACT treatment condition. A Yoga instructor chosen by the neurologists at the epilepsy clinic was responsible for the Yoga condition.

The treatment involved four sessions; two individual and two group sessions. Booster sessions were provided after the six-month and one-year follow-up. Individual and booster sessions lasted for 1.5 hours while group sessions lasted three hours. Total therapy time for each participant was twelve hours. The same amount of time was given to participants in both groups.

Dependent variables were seizure index (seizure frequency * seizure duration) and quality of life. To measure the dependent variables seizure index (seizure frequency * seizure duration), SWLS and WHOQOL-BREF were used. For a more thorough description of the measurements, see the method section in study I.

Statistical analysis

The statistical analyses were carried out using Statistica 6.0 (Statistica, 2002). Due to significant pretreatment differences in seizure index, independent and dependent t-tests on pre to post change scores were used to detect differences over time and between groups. To detect differences between groups over time with regard to quality of life, mixed ANOVAs (2 groups x 4 time) and one-way ANOVAs were employed. Cohen’s $d$ effect sizes were also calculated.

Results

The results of the study showed that both the ACT intervention and the Yoga intervention significantly decreased the seizure frequency and duration over time. Half of the participants in both groups were seizure free at the one-year follow up. The seizure index decreased significantly more in the ACT group.
results of study II show that persons suffering from recurrent epileptic seizures despite medication will most likely benefit from a complementary treatment along with medication. Seizure index and quality of life were affected following treatment in both groups. The results strengthen the hypothesis that epileptic seizures and associated problems can be treated using behavior-oriented interventions.

Discussion

The research questions asked what the effects of ACT treatment and yoga treatment of epilepsy combined with medication was on seizure index, seizure frequency, and quality of life. The results show that seizure index and frequency were affected following both treatments but that the ACT group affected seizure index significantly more. Half of the participants in both groups were seizure free at the one-year follow up. The results indicate that more research is needed to evaluate the effects of Yoga and ACT on seizure index and frequency. The results regarding quality of life are also mixed. Both treatments significantly affected quality of life. The results of this study do not allow us to state that one treatment is better than the other regarding quality of life. For future research it would be important to evaluate both the ACT and Yoga components.

ACT and Yoga appeared to be similar in several ways. Both treatment models include acceptance and mindfulness processes as part of the intervention. Participants were instructed not to consider thoughts and feelings as truths, instead to just be aware that they are elicited under certain circumstances. Private events arise in specific situations, but are not necessarily the reason for certain actions. From a behavioral point of view, instead of acting as...
usual under these circumstances, practicing acceptance and mindfulness may create a pause between trigger and behavior, which could increase the possibility of seizure abortion. Seen in the light of learning theory, acceptance and mindfulness could in both groups be viewed as countermeasures aimed at building psychological flexibility. Both the Yoga instructor and the ACT therapists talked to clients about doing what really matters to them even in the face of emotional and cognitive discomfort. This may explain why participants in both groups increased their quality of life, but also decreased their seizure index. Clients acted differently toward events that had previously triggered a vicious behavioral circle leading to a full-blown seizure. Doing what matters to the clients in the face of difficulties may change the likelihood of seizure development and can therefore be considered a countermeasure.

The results of the present study give rise to hypotheses regarding mechanisms of change in behaviorally oriented treatments of epilepsy. Both treatments included acceptance, defusion, and activation in valued direction processes, which affected seizure frequency, index, and quality of life. It would be worthwhile exploring those processes in future research. Studies examining treatment components and their contribution to outcome are important for future research.

The small number of participants in the study may be a methodological limitation. However, detecting differences despite a small number of participants makes the results interesting due to the fact that it is often harder to detect differences using small samples. Future research would benefit from the inclusion of a greater number of participants because there is a lack of studies with large samples.

The dependent variables were significantly affected after both the Yoga and the ACT intervention. The study would have benefited from a third comparison group. Although it is unlikely, the changes could be due to other variables such as medication or attention. The participants had been medicated for many years but still had the same number of seizures. There were no medical changes during the project, which makes it unlikely that changes were due to medication. For future research, a third comparison group controlling for variables such as attention would have the potential to make the research more methodologically robust.
Study III:
Evaluation of mediators of change in the treatment of epilepsy with acceptance and commitment therapy

Introduction
There are studies indicating promising effects of behavior therapeutic interventions for epilepsy but the workable mechanisms of change in those treatments have not been identified (Mittan, 2009). There is a lack of knowledge about the effective therapeutic mechanisms in the treatment of epilepsy as well as in the treatment of other cognitive and behavior problems (Longmore & Worell, 2007; Hofmann & Asmundson, 2008). There is a need to conduct well-designed studies evaluating the effect of behavioral treatment for epilepsy as well as determining the processes of change. Understanding the processes of change in behavior therapeutic interventions may increase our knowledge of how to develop effective therapies, which is of the utmost importance for those who suffer from recurrent seizures despite medication.

Aim
The aim of this study is to examine specific mechanisms of change in ACT treatment for epilepsy.

Research question
What are the mediational effects of ACT processes such as epilepsy related psychological flexibility, values attainment and persistency in overcoming barriers on seizure frequency, duration, and quality of life in ACT treatment for epilepsy?

Method
This study examined mechanisms of change in ACT treatment for epilepsy (Lundgren et al., 2006) through a set of mediational analyses on key ACT processes and their relation to one-year outcome. The processes examined were: epilepsy related psychological flexibility, values attainment and persistency in overcoming barriers. Psychological flexibility and persistency in overcoming barriers have been examined in several previous ACT studies (Bond & Bunce, 2000; Gifford et al., 2004; Gregg et al., 2007). This study is the first to evaluate values attainment as a mediator. These three areas (Values attainment, psychological flexibility, and persistency in overcoming barriers) were selected because they are central to an ACT model and measures were available for use with the population studied.
Measurements

Two instruments were used to evaluate the mediators; the Bull’s-Eye instrument of valued living and the Acceptance and Action Questionnaire for epilepsy (AAEPQ). Both instruments were developed for the study presented in this dissertation.

The Bull’s-Eye instrument of valued living has a satisfactory criterion-related validity and a test-retest reliability of .86 (Lundgren et al., 2006). The Bull’s-Eye instrument is designed as two dartboards. On the first dartboard, participants are asked to; 1) define a value and a valued direction, 2) write an X on the dartboard where it best represents how well the participant has lived according to the stated value during the previous two weeks. An X in the middle of the Bull’s-Eye means perfect consistency between the person’s actions and defined values. An X far from the middle of the Bull’s-Eye suggests that the participant has not lived according to the defined values during the previous two weeks. Participants were asked to mark three dartboards on three important areas of life. 3) On the last dartboard the participants were requested to describe their barriers to living in accordance with the previously defined valued directions. 4) Finally, they were asked to put an X on the dartboard where it best represents how often they persisted in their valued direction, even in the face of the described barriers and emotional difficulties. An X in the middle of the Bull’s-Eye suggests that the participant always acted in valued directions, even in the face of the stated barriers during the previous two weeks. An X far from the middle of the Bull’s-Eye suggests that when barriers arise, no action in the valued direction was taken. The distance between the middle of the Bull’s-Eye and the participant’s marks was measured using a ruler and a pen. The distance between the middle of the Bull’s-Eye and the outer circle is 4.5 centimeters.

The AAEPQ is based on a modification of the items in the AAQ (Hayes et al., 2004) to suit epilepsy. The AAQ has been used effectively as a process measure in a number of studies evaluating ACT specific processes (Hayes et al. 2006; Bond & Flaxman, 2006). The AAEPQ consists of 10 questions where the participants rate the truth of each statement as it applies to them. The scale ranges from 1-7 where 1 = never true and 7 = always true.

The primary outcome measure used was total seizure time per month verified by nursing records. Three self-reported outcome measures were obtained: WHOQOL-BREF, SWLS, and the Personal Well Being Index. SWLS and WHOQOL-BREF are described in more detail in study I.

The Personal Well Being index (PWI) used in this study consists of seven questions about general well-being for persons with intellectual disabilities.
(Cummins, 1991). Participants are asked to rate how happy or sad they feel about their life situation in several areas on a scale between 0 and 10. Higher scores equal higher well-being.

Statistical analysis
The mediational impact of post measures of ACT processes on pre to follow-up differences in quality of life, well-being, and seizure outcomes was assessed using a non-parametric bootstrapped multivariate approach developed by Preacher and Hayes (2004). The Preacher and Hayes (2004) mediational analysis procedure allows the possibility of analyzing the effect of multiple mediators. Only values that reached conventional significance levels were analyzed.

Results
Three of the four measures; seizure time, WHOQOL-BREF, and PWI showed evidence of mediation by ACT processes. The strongest mediator for seizure time was psychological flexibility measured by the AAEPQ. Values attainment and persistency in a valued direction in the face of barriers also functioned as mediators, both alone and in combination. The impact of treatment on seizures at the one-year follow up was significant ($t = 4.52, p < .001$) but when the mediational effect of the post values of epilepsy-related psychological flexibility was included, treatment was no longer related to seizure outcomes ($t = 1.86, p = ns$).

Quality of life measured by the WHOQOL-BREF and the PWI was mediated by a combination of values attainment and valued action in the face of difficulties. The impact of treatment on quality of life measured by the WHOQOL-BREF at the one-year follow up was highly significant ($t = 5.23, p < .0001$) but when the mediational effects of values attainment and persistence in valued action were included, treatment was no longer related to quality of life outcomes ($t = 1.37, p = ns$). The PWI indicated the strongest and most statistically significant mediation. Values attainment and valued actions in the face of difficulties functioned as mediators both alone and in combination. The impact of treatment on personal well-being at the one-year follow up was highly significant ($t = 5.25, p < .0001$) but when the mediational effect of the two value measures at post were included, treatment was no longer related to well-being outcomes ($t = 1.34, p = ns$). However, the SWLS had no significant mediation effects at the one-year follow up.
Discussion

This study indicates that changes in outcome in a contextual behavior therapeutic intervention for epilepsy combining ACT processes and specific behavior techniques may be due to the former. Psychological flexibility seems to influence epileptic seizures, while value attainment and valued actions in the face of barriers seem to affect quality of life. This study is small and is therefore less likely to show good effects due to low power. The fact that it presents good results despite low power makes these results even more interesting and important to take into consideration in future research.

While it is important to evaluate treatment packages, it might also be worthwhile to evaluate mediational effects to increase our knowledge of how to design effective treatment. Evaluating mediators might facilitate the design of effective treatments that focus directly on processes contributing to positive outcomes. The present study has tested the influence of mediators but more studies are needed to better understand the contribution of the processes, which should be tested separately and not as part of treatment packages.

Some methodological concerns need to be highlighted. It is desirable that changes in the mediators occur before changes in the outcome variable. This is the case for the mediational effects of quality of life as measured by the WHOQOL-BREF. Psychological flexibility, values attainment, and persistence in valued directions in the face of emotional barriers changed at post treatment follow-up while the WHOQOL-BREF did not change until the 12 month follow-up. This time difference between changes in mediator and change in outcome strengthens the hypothesis that the mediating processes actually function as real mediators. However, the seizure index and the PWI changed significantly at post treatment follow-up, as did the mediators, which means that the change in mediators did not necessarily precede the change in outcome. There is a risk that changes in outcome are considered to be caused by changes in the mediator. It is possible that this is the case but the current data do not allow us to draw such conclusions. In future research, further understanding of mediation could be attained through an increased number of measurement occasions.

The results presented in this study suggest that ACT processes such as value attainment and psychological flexibility need attention in future research. The present study is too small to examine precisely how separable but related ACT processes and specific outcomes correlate over time, but it does provide evidence that these processes merit further exploration. Evaluation of the mediational effects of other processes in ACT therapy such as countermeasures, exposure, mindfulness etc would add to the understanding of the mechanisms of change in ACT therapy for epilepsy.
General discussion

Is it time to shift from a medical model to a behavior medicine model in the treatment of epilepsy?

The present dissertation starts with the question of whether a shift should be made from a medical model to a model where medical and psychological knowledge are combined to make epilepsy treatment more effective. This dissertation suggests that a combination of medication and ACT is more effective than medical treatment alone in the treatment of epilepsy and related problems. The results presented show that the frequency and duration of epileptic seizures decreased following ACT treatment combined with medication as compared to active control groups. Quality of life increased significantly for the participants in the ACT group and the changes were mediated through ACT processes. The results presented in this dissertation support the integration of behavioral based interventions as a complement to medical treatment for those who suffer from recurrent seizures and associated problems despite medication.

Recent studies suggest a need to complement medical interventions with psychosocial interventions (such as behavior therapy, ACT etc.) to offer as effective a treatment as possible for those who suffer from epilepsy (Mittan, 2009; Beyenburg et al., 2005; Elger & Schmidt, 2008). The conclusion of these studies is that there is a need to shift from a medical model to a behavior medicine model where medical and behavioral science are considered in the treatment of epilepsy, which is supported by the results presented in this dissertation.

According to the medical model, the development of an epileptic seizure assumes a one-way interaction between a neurological disruption in the brain and a behavior symptom (seizure). However, the model is not fully satisfactory. There are still those who suffer from recurrent seizures despite medical treatment (Zaccara, Gangemi, & Cincotta, 2008). The hypothesis of a one-way correlation between a neurological disruption in the brain and a behavior symptom is questioned in this dissertation and in previous research (Swinkels, Kuyk, & Van Dyk et al., 2005; Kanner, 2009; Wolf, 2005; Dahl 1992). Psychological concepts such as operant and respondent conditioning
and the unique human ability of relational framing suggest some therapeutic implications, which according to the results presented in this dissertation influence seizure frequency and quality of life. The mediational analysis study presented in this dissertation indicates that the mechanisms of change in ACT treatment are to some degree due to psychological factors, such as values attainment and psychological flexibility. The results support a complementary behavior medicine approach where biological, psychological, and social factors are analyzed in relation to each other in order to understand epileptic seizures and design effective treatments. However, there are still questions regarding how epileptic seizures are elicited, maintained, and how treatment best should be designed to be as effective as possible.

Contributions of the research presented in the dissertation

The studies presented in this dissertation add in at least four ways to previous research suggesting that it is possible to effectively treat persons suffering from epilepsy using a behavior approach.

The first contribution to the previous research base is the improved study design. The authors of the recent Cochrane review (Ramaratnm, Baker, & Goldstein, 2008) concur that there is a lack of randomized controlled trials evaluating the effects of behavior treatment of epilepsy. A few studies adopt a randomized controlled research design for adults (e.g., Dahl, Melin, & Leissner, 1988) but there is a need for more. The studies presented in this dissertation adopt a randomized controlled trial design with active comparison groups. Nevertheless, the number of participants in the studies was low and larger trials are needed.

The second contribution entails the evaluation of mechanisms of change. Previous research has shown that behavior therapy influences seizure probability (e.g., Dahl, Brorson, & Melin, 1992; Dahl, Melin, & Leissner, 1988; Dahl, Melin, & Lund, 1987; Dahl, Melin, & Brorson et al., 1985), but the mechanisms of change have not been evaluated. The mediational analysis study presented in this dissertation suggests that changes in seizure frequency and quality of life are to some degree due to processes such as psychological flexibility and value attainment. This finding indicates a need for further attention to mechanisms of change in behavior treatment of epilepsy in order to develop effective treatment.

The third contribution is the integration of previous behavior management techniques into an ACT frame. Previous behavior management techniques have targeted epileptic seizures directly, but quality of life has not been a focus (Dahl, Brorson, & Melin, 1992; Dahl, Melin, & Leissner, 1988; Dahl, Melin, & Lund, 1987; Dahl et al., 1985). Integrating earlier behavior man-
agement techniques into an ACT frame broadens the treatment to target quality of life as well as influencing the frequency of seizures. The integration of earlier behavior therapeutic techniques into an ACT frame are not controversial due to the fact that ACT is a model based in behavior psychology. However, the result from the mediational analysis raises questions regarding what the mechanisms of change actually are in behavior treatment of epilepsy.

Finally, the results presented in the dissertation demonstrate the feasibility of implementing ACT as a complementary model in outpatient clinics even when there are language barriers and a need for interpreters. The dissertation suggests that it is possible to make a difference in spite of cultural dissimilarity between therapists and clients. Interpreters and staff members at the clinics only participated in a half-day workshop about the treatment model which, even though seemingly little, appeared sufficient for overcoming both language and cultural differences.

Limitations and methodological issues

The number of participants in the studies presented in this dissertation is low and may potentially lead to misinterpretation of the results. There is a risk that a large change for a single participant could affect the mean change and thus distort the interpretation of the results. There is a risk of type I or type II errors. In study II, the presentation of individual case data makes it possible to evaluate not only group mean but also individual changes. All of the participants’ seizure frequencies changed at post treatment. However, with larger samples, the risk of making type I and type II errors is reduced. For that reason, more research with an increased number of participants is needed.

There is an assessment problem in the studies. The researchers responsible for the studies also conducted parts of the assessment along with interpreters. Even though we consider ourselves as objective, there is a risk of assessment bias. This is not a problem related to seizure frequency and duration in either of the studies. In both studies I and II, the medical staff that collected the data did not know into which group the participants had been randomized. In that regard the persons conducting the assessment were blinded. However, the first and second authors, partly assisted by translators, conducted the assessment of self-reported quality of life, which may have affected the way the participants answered. In future research the use of independent and blinded assessment administrators may control for the methodological problems associated with assessment.
Conclusion

In conclusion, this dissertation suggests that ACT treatment, as a complement to medical treatment, was effective for clients suffering from recurrent epileptic seizures. Contextual behavior therapy as a complement to medical treatment seems to be effective and necessary for many of those who suffer from recurrent seizures despite medication. There is still a lack of well-designed studies examining the effect of behavioral interventions for epilepsy as well as mechanisms of change. This dissertation adds three more studies to the research base although new research questions have arisen. As discussed above, an increased number of participants are needed in future studies. Methodological changes could further increase the strength of the results. Furthermore, how the medical and behavior model should best be integrated to meet the needs of those who suffer from epilepsy and related problems needs further attention.
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