PERSISTENT ENURESIS
AND
AWAKENING RESPONSE

by

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This dissertation is submitted in partial fulfillment of the requirements for the degree of Master of Social Science in Clinical Social Work in the Faculty of Social Science and Humanities at the University of Cape Town.

Supervisor

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Declaration

All information in this paper has been originally compiled and composed by the author and the format and all references have been acknowledged according to the Publication Manual of the American Psychological Association (2nd Edition). The study conducted is an original study with no falsification of information or results. All compiling of results and testing of information was conducted by the author according to Understanding Social Statistics by Gene M. Lutz.

Sincerely,

Signed by candidate

Carla Crews

Student - Masters in Clinical Social Work

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University of Cape Town, March 1987 Carla Crews

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Abstract

Ten primary nocturnal enuretic children and twenty-eight non-enuretic children between five and twelve years of age were subjects for a measurement of awakening response. A buzzer was sounded two hours after the child's bedtime ("lights-out") and the length of time it took the child to turn off the buzzer was recorded. If the child did not respond within 120 seconds (2 minutes) a non-awakening response was recorded. The subjects were tested three random nights by the parent(s) of the subjects. The parents were given verbal and written instructions for the use of the buzzer and stop-watch utilized for timing. Data (date, time child went to bed, time tested, duration of buzzer, and ability to remember testing) was recorded on a form supplied by the researcher. A letter stating the purpose of the study was given for explanation of the testing process. Information as to the frequency of enuretic episodes, history of enuresis in family and a case number was obtained for each subject. All of the subjects were volunteers from the general population

Abstract (cont)

(e.g., schools, churches). None of the enuretic subjects were receiving treatment at the time of testing. Data was collected by the reseacher and a chi-square test was utilized to compare the awakening response of enuretic and non-enuretic children. The results showed a significant difference in the awakening response of the two groups, the enuretic group showed a higher frequency of non-awakening responses. It was also found that the younger children (ages 5 - 8) had a lesser ability to awaken to the external stimulus of the buzzer as compared to the older children (ages 9 - 12). The awakening ability of the 5 - 8 year old group of enuretic and non-enuretic children was not significantly different but the awakening ability of the 9 - 12 year old age group of enuretic and non-enuretic children was significantly different. The 5 - 8 year old non-enuretic children showed a significantly lesser awakening ability than the 9 - 12 year old non-enuretic children. The age groups within the enuretic sample showed no significant difference in awakening ability. The results indicate that

Abstract (cont)

enuretic children have a lesser ability to awaken than non-enuretic children. This lends support to the hypothesis that enuretic children have a lesser ability to awaken than non-enuretic children and merits further study over larger samples of the population.

PERSISTENT ENURESIS AND AWAKENING RESPONSE

Enuresis is a common disorder, affecting 15% of 4 - 5 year-old, 5% of 10 year-old, and 1% of 15 year-old children (Wagner, Johnson, Walker, Carter, & Wittner, 1982). Although many etiologies have been proposed and various treatments have been applied to this disorder the author found through an extensive literature review and practical experience with noctural enuretic subjects that additional information and comparisons between enuretics and non-enuretics are needed.

As a result of this literature review and her involvement in the training of eleven enuretic children the author came to question whether enuretic children have the same awakening ability as non-enuretic children. Parents reported in the author's study, "Parent-Child Directed Nocturnal Enuresis Control by Use of the Buzzer-Pad Method" (1982), that the enuretic children had difficulty in being aroused and becoming fully awakened.

It is the intent of this study to examine the awakening ability of enuretic children and non-enuretic children when exposed to an external stimulus, an enuresis alarm buzzer, and to compare

the two groups. Because of the confusion of etiology and treatment of this common pediatric problem, the study could add useful information in terms of additional understanding of the enuretic child.

I Review of the Literature

Definition

Occurrence

Etiologies

Definition. Noctural enuresis is an involuntary discharge of urine occurring during sleep. Enuresis can be divided into two categories, persistent and regressed or acquired enuresis. The two categories have also been termed primary and secondary enuresis respectively. Persistent enuresis is bedwetting from birth and acquired enuresis denotes enuresis that has recurred following at least six months of night time continence (Stephens, 1970). Enuresis is diagnosed after the age of three to four years in the absence of any demonstrable anatomical or morphological pathology (Lovibond, 1964).

The more recent and generally accepted criteria is given in the Diagnostic and Statistical Manual of Mental Disorders,(DSM III). The 1980 edition has raised the age level for primary enuresis and duration of continence for secondary enuresis. Functional Enuresis is often referred to as primary if it has not been preceded by a period of urinary continence for at least one year, and secondary if it

has been preceded by a period of urinary continence for at least one year. (American Psychiatric Association, 1980). The DSM III states that the term enuresis is defined as the involuntary voiding of urine at least twice a month for children between the age of five and six and once a month in older children.

The clinical definitions of enuresis found in the literature vary widely, thereby restricting the comparability of studies on enuresis. The diagnostic criteria in the DSM III are a step towards a generally accepted definition, although the criteria are rather arbitarily chosen (Verhulst, Van der Lee, Akkerhuis, Sanders-Novostra, Timer, & Donkhorst, 1985).

The first recognition of enuresis as a medical problem occured as early as 1550 B.C. when juniper berries, cypress, and beer were prescribed for incontinence of urine (Glicklich, 1951). There is no other known account of enuresis until the Middle Ages when many barbaric and ritualistic treatments were practiced (Glicklich, 1951).

During the 19th century relative factors became recognized as connections to enuresis. These were deep sleep, family tendency toward the disorder, imbalance of musculature in the bladder, irritation, noctural erections, neurological explanations, and the first association between psychological factors and enuresis (Stephens, 1970).

All these factors helped to extend confusion about enuresis which resulted in a variety of treatments. Various theories and treatments entered during the 20th century causing the problem of enuresis to be a controversial issue.

OCCURRENCE. The minimum estimate of the normal 5 and 6 year-old population who wet the bed is 19% (Sears, Maccoby, & Levin, 1957). Another estimate states that 20% of all 5 year-olds, 10% of 8 year-olds, and 2% of teens suffer from enuresis. ("New Solutions to Bedwetting", 1981). It was stated in another text that the general public finds it hard to believe the expert opinion that not less than 7 to 10% of all children between ages 4 and 14 are persistent bedwetters (Baller, 1975). Dr Martin Scharf, director of the Sleep Disorders Laboratory at

Jewish Hospital of Cincinnati, claims that 10% of 6 year-olds are enuretic and the spontaneous cure rate after age 6 is only 15% per year ("Newly Awakened Interest in Sleep Research Spans Many Specialities", 1985). Enuresis is a widespread problem among the pediatric community. In fact, 1 in 50 Army draftees in World War II were still enuretic at age 18 (Hallgren, 1957).

ETIOLOGIES AND TREATMENTS. Even though enuresis is quite common among children and is associated with parental and child distress, few parents seek medical treatment for the affected child (Miller, 1973). Only one third of all bed-wetting children followed through age 11 years ever saw a physician about the condition (Foxman, Valdez, Brook, 1986).

For those children who obtain medical care, diverse treatments are prescribed for the control of enuresis. The major contemporary methods are psychotherapy, drug therapy, bladder stretching, and behavior modification.

Most psychotherapists who treated enuretics for enuresis alone report a painful lack of success resulting from psychotherapy (Silberstein, 1973).

In a study by DeLeon & Mandell (1966) the difference between the success of those treated by psychotherapy and control groups was relatively insignificant.

The drug imipramine (an anti-depressant marketed as Tofranil and Presamine) is often prescribed for enuretics. According to Dr. Chris Carstens of Kaiser-Permanete Medical Centre in San Diego, director of one of the few enuresis clinics in the United States, imipramine is not effective as a long-term treatment. Approximately 40% of enuretics who do well initially with the drug begin wetting again once it is discontinued ("New Solutions to Bedwetting", 1981).

Imipramine will suppress wetting completely in about 30% of bedwetters and will reduce wetting frequently in a further 50% (Drug and Therapeutic Bulletin, 1977). Relapse rate after withdrawal of medication is variable, but within 3 months of stopping treatment many children will wet as much as they did before treatment was started (Drug and Therapeutic Bulletin, 1977).

Imipramine is used in treating symptoms of depression. The drug is a mild sedative which can

elevate moods, increase physical activity and mental alertness, and improve appetite and sleep patterns (Silverman & Simon, 1982). A dose of 25 milligrams per day (age 6 and over), one hour before bedtime, is the minimal dosage. If continence is not achieved within one week, the dose is increased to a daily 50 - 75 milligrams, depending on age. A dose greater than 75 milligrams will increase side-effects without increasing effectiveness (Silverman & Simon, 1982).

Some possible side effects are changes in blood pressure, abnormal heart rates, confusion, hallucinations, disorientation, delusion, anxiety, restlessness, excitement, numbness and tingling in the extremeties, lack of co-ordination, inability to urinate, rash, itching, loss of appetite, stomach upset, and others. Possible adverse drug effects include inability to sleep, nightmares, feeling of panic, increased or decreased weight, weakness, stomach cramps, frequent urinations, and others.

The Drug and Therapeutic Bulletin (1977) states that drugs should not be the initial treatment for enuresis. Although some drugs may "suppress" enuresis, permanent continence is unlikely (Drug and Therapeutic Bulletin, 1967). Furthermore, the most

effective drugs, the tricyclic antidepressives, pose a significant risk of intoxification and accidental poisoning in younger children (Goel & Shanks, 1974). These drugs, cardiotoxic and potentially lethal in overdosage, are now the commonest cause of fatal poisoning in children under the age of five years yet their usage increases despite warnings of their dangers (Attenburrow, Stanley, & Holland, 1984).

The lack of success of drug therapy or psychotherapy could possibly be related to the increasing evidence that enuresis is not an emotional disorder (Stephens, 1970). It is most commonly the result of delayed maturation of bladder control, and rarely associated with urinary tract disorders or psychological illness (Drug and Therapeutic Bulletin, 1986). There is a popular and supported view that enuresis is due to delayed development and/or nonlearning (McDonald & Trepper, 1977).

Werry and Cohrssen (1965) concluded from a comparison of 34 never dry clinic patients who wet at least once a week with 34 non-enuretic siblings who had been dry since the age of 4 that enuretic children had a higher probability of emotional

disturbance but that there was no reason to assume that enuresis in a given child was necessarily the result of psychopathology.

Hallgren (1956) reported from published reviews of the literature that there was no association of nocturnal enuresis with two measures of "nervous behavior". One measure was developed from a questionnaire and one from a school health card.

The growing opinion is that persistent or primary enuresis and acquired or secondary enuresis are of different etiologies. According to this hypothesis, never dry enuretics would be expected to show a closer association with neurological measures and a not-so-close association with social or psychological factors when compared to relapsers or acquired enuretics (Oppel, Harper, & Rowland, 1968).

The relationship between enuresis and behavior problems was examined in a study conducted by McGee, Makinson, Williams, Simpson, and Silva (1984). Primary enuresis was defined as wetting at least once a month with no period of continence of at least 1 year's duration prior to onset. The authors found that the secondary enuretic children were given higher problem scores according to the Rutter Child A

and Child B Scales (Rutter, 1973) than the scores of non-enuretic children. The primary enuretic children, on the other hand, did not differ significantly from the non-enuretic children at either age. (McGee et al., 1984).

For the majority of enuretics, to be a bedwetter carries adverse emotional consequences, and many exhibit some degree of reactive disturbance (Morgan & Young, 1972). What is required by the treating professional is a relatively simple and well-substantiated form of treatment which offers a high probability of cure without harmful side effects.

A form of treatment dealing with the nonlearning aspect is the enuresis alarm or buzzer-pad method developed by O.H. Mowrer in 1938. The function of this apparatus is simply to provide an automatic means of awakening the child immediately upon the commencement of urination instead of allowing the child to complete this act and sleep placidly on until morning. A regular waking schedule may or may not prove effective in establishing the desired dry habit (Mowrer, 1938).

The Mowrers reported a 100% "cure rate" of 30 children who reached a criterion of 14 consecutive dry nights within 2 months after the onset of treatment (Gresham, 1980). In a large study by Silberstein (1962) the Mowrer device was redesigned and applied. The success rate with the Mowrer device in uncomplicated enuretics was 85 per cent (Silberstein, 1973). Most patients using the alarm and working closely with their doctor achieve dryness within six weeks, report psychologists at the Mayo Medical School's Enuresis Conditioning Program, though the remission rate is about 30%. ("New Solutions to Bed-Wetting", 1981). Geppert (1953) reports that as many as 91% of the bedwetters in pediatric outpatient practice can be cured by the classical conditioning method of Mowrer and Mowrer.

The success of conditioning treatment in practice has been well demonstrated (Morgan & Young, 1972). Young (1969) lists 19 clinical studies of such treatment in which the percentage of success rate ranged from 63% to 100%. Enuresis alarms effect a cure in a higher proportion over the age of 7 than can be achieved by other forms of treatment

("General Practitioners Should Be Able to Prescribe Enuresis Alarms on the NHS", 1984).

With the percentages of success reported it is surprising that the conditioning methods have not been generally accepted as the treatment of choice. According to the article "General Practitioners Should Be Able to Prescribe Enuresis Alarms on the NHS", (1984) general practitioners may not prescribe these on the NHS. Morgan & Young (1972) stated the use of conditioning treatment for enuresis has yet to find wide acceptance among social workers and those entrusted with the residential care of children.

Foxman, Valdez, and Brook (1986) examined prevalence, perceived impact, and prescribed treatments in childhood enuresis. Of the 92 children who saw a physician, 55 (60%) received one or more treatments. They found Tofranil was the most frequently prescribed treatment. The most commonly recommended regimen in the literature - the bed alarm - was prescribed for only three children (Foxman, Valdez, and Brook (1986).

One possible explanation according to Stephens (1970) is that enuresis alarms require a concerted effort and subjects both parent and child to

inconvenience. Successful use of the alarm requires extensive co-operation of parent and child and lengthy instruction by the physician (Foxman, Valdez, and Brook, 1986). Without the aid of consultation by a doctor, psychologist, or counselor, parents can become discouraged because of a lack of understanding concerning the process and concept.

Perhaps one of the major reasons for the presently limited acceptance of conditioning treatment by social workers (professionals), is that many, not conversant with such conceptualization of enuresis, have permitted certain common and popular assumptions to escape rigorous questioning (Morgan & Young, 1972). Because enuresis is seen as a somatic expression of emotional disturbance it is assumed that there is a causal relation between enuresis and disturbed behavior and therefore this concept is accepted without question. Such inference is in contradiction with the research findings of Tapia et al. (1960), who found that disturbed children are not especially prone to enuresis, nor enuretics particularly prone to disturbance, and of Baker (1969), who found neither projective personality tests nor assessment of adjustment by psychologists

to distinguish enuretics from non-enuretics (Morgan & Young, 1972).

Oppel, Harper, and Rowland (1968) examined social, psychological, and neurological factors associated with noctural enuresis in a longitudinal study of 859 children. They found that it was only after they began to separate primary and secondary enuretics that the pattern of association became clear. According to their findings, relapsers came from significantly larger families than non-relapsers or primary enuretics and their results did not support any relationship between anxiety, tenseness, or dependency and enuresis.

Enuresis has stubbornly resisted all attempts to assign it a structural pathology and, furthermore, it is a condition notoriously resistant to therapeutic intervention (Werry, 1967). Because of its complex etiology, enuresis presents a challenge to the physician's ability to diagnose not only pathology but also psychopathology (Werry, 1967).

Regardless of the etiology, Starfield (1972) claimed that enuresis as a sympton had three regularly associated findings in 256 enuretic children. One of these findings was that most

enuretics void more frequently during the day than comparable non-enuretics, but they do not void larger volumes of urine, either during the day or night, than do non-enuretic children (Starfield, 1972).

Esperanca and Gerrard (1969) measured bladder capacity by means of the water load test in 297 normal children and 50 children with enuresis. They found that most enuretics pass urine more frequently than do normal children during the day time, in addition to bedwetting at night.

Starfield's second association was that when enuretics were compared with nonenuretic children of similar age or with their nonenuretic siblings, they were found to have a smaller functional bladder capacity. The data gathered by Esperanca and Gerrard confirmed the observations of Hallman (1950), Muellner (1960), and Starfield (1967) that most enuretics have smaller bladder capacity than normal children.

The third association was that electroencephalographic correlation studies indicate that enuresis does not occur during dreaming, but rather during the predream non-rapid eye movement (non-REM) stage of sleep. Pierce, Whitman, Moss, and Gay (1961)

suggested that the common relationship of a dream (which occurs during REM sleep) to an episode of enuresis is that the dreams do not appear until after the child has wet. Broughton (1968) found through his statistical investigations that there is no evidence that REM sleep and its concomitant dreaming play any role in the genesis of the enuretic episodes. Sophisticated experiments have shown that micturition is initiated during the first stages of arousal from the very deepest, "slow-wave" sleep (Nocturnal Devils, 1968). Therefore, very few enuretic episodes are related to or generated by dreaming.

Although Gastaut and Broughton (1965) and Peirce et al. (1961) showed that enuresis occurs predominantly during NREM sleep it was also found that the bedwetting episodes occured throughout the night with some preponderance in the first third of the night. These results were later confirmed by Ritvo, Ornitz, Gottlieb, Poussaint, Mason, Ditman, and Blinn (1969).

Practitioners continue to explore the perplexing etiology and associations of enuresis and attempt to develop more effective treatments to obtain a cure. Table I gives examples of the diverse etiologies and treatment that have been proposed by those in this

field of study.

Several conditioning methods have incorporated the Mowrer device or a derivative of the Mowrer enuresis alarm. One of the most recognized is the Dry-Bed Training (Azrin, Sneed, and Foxx, 1974). Azrin and his associates claimed this procedure to be a more effective and rapid treatment than the traditional alarm developed by Mowrer in 1938.

Dry-Bed training (DBT) employs the use of the standard enuresis alarm or buzzer-pad method but adds features such as training in rapid awakening, practice in withholding urination, self-correction of toileting accidents and increased social motivation to eliminate the problem of enuresis (Bollard & Nettelbeck, 1981). An outside trainer conducts an intensive all-night program within the child's home and then a post-training supervision program is carried out by the child's parents until continence is achieved.

The Dry-Bed method has shown favourable results (Azrin, Sneed, and Foxx, 1974; "New Solutions to Bed-Wetting", 1981). However, the professional needed to conduct the intensive all-night training brings about problems of cost, time and lack of trained personnel (Bollard & Woodruffe, 1977).

The Dry-Bed method can be advantageous over the

TABLE I

Studies of Enuresis

Authors	Proposed Etiology	Suggested Treatment
Azrin et al., 1974	Learning Deficiency	Dry-Bed Training
Broughton, 1968	Disorders of Arousal from Sleep	
Drug & Therapeutics Bulletin, 1986	Delayed Maturation of Bladder Control	Enuresis Alarms
Edvardsen, 1982	Defective of Insufficient Feedback Inhibition of the Bladder Resulting in Decreased Bladder Capacity and the Urgency of Micturition	Conditioning Therapy

TABLE I (cont)

Esperanca and Gerrard, 1969	Small Bladder Capacity	Bladder Stretching Exercises
Kales et al., 1977	Bladder Excitability and/or Bladder Capacity	Drug Therapy
Lovibond, 1964	Learning Deficiency	Conditioning Therapy
McConaghy, 1969		Conditioning Therapy
Morgan and Young, 1972	Learning Deficiency	Conditioning Therapy
Mowrer, 1938	Learning Deficiency	Conditioning Therapy

TABLE I (cont)

Seiger, 1952 Therapy,	Learning Deficiency	Conditioning Enuresis Alarm
Starfield, 1967, 1972	Small Bladder Capacity	Bladder Training Stretching

buzzer-pad method alone because of intensive training on the part of the parent and child and the development of an awareness of the concept behind the process. The method also incorporated training that deals with the associations of enuresis summarized by Starfield (1972) such as rapid awakening and bladder stretching by withholding urination. The Dry-Bed training without the standard urine-alarm has proven to be substantially the same as no treatment at all ("Dry-Bed Training Without an Enuresis Machine", 1979) and as reported by Bollard and Nettelbeck (1981), the procedure without a machine was only partially effective in reducing bedwetting frequency.

Fincham and Spettell (1984) conducted two studies to investigate the acceptability of the most recent version of the Dry-Bed Training and urine alarm training. The first study compared evaluations of parents who participated in 8 week training program consisting of either the DBT or urine alarm training. The second study evaluated responses to the treatments independently of their implementation.

Parents who had actually implemented the treatments rated the urine alarm procedure more favourably than DBT on both the Treatment Evaluation

Inventory and the Evaluative dimension of the Semantic Differential (Fincham & Spettell, 1984). The parents seemed to have greater difficulty implementing the DBT because of child noncompliance and overly demanding procedures.

The second experiment showed that the recommended treatment acceptability was dependent on its source. A program was considered more acceptable when offered by a clinic than when presented as a self-help manual (Fincham & Spettel, 1984).

In summary, the literature reveals a higher success rate with the standard enuresis alarm although it may not be the most generally accepted method. Regardless of the etiology it seems logical to accept that bedwetting could be most effectively eliminated by pairing the urge to urinate with awakening. This simple conditioning would eventually increase awareness in the area of bladder control and arousal without intensive or extensive trauma on the child and parent and without harmful side effects.

In accordance with the findings of Fincham and Spettell, it would be most beneficial to implement the conditioning method with counselor supervision and consultation. This would help eliminate faulty

implementation and misunderstanding of the already frustrated parent and child.

It must be noted that the distinction between primary and secondary enuresis is usually necessary for treatment purposes. The physician must first establish whether the enuresis is primary or secondary (Nesbit, 1972). For those with secondary enuresis, psychologic evaluation is often indicated (Kales & Kales, 1974).

McGee et al., (1984) found that primary enuresis was not associated with an increase in behavioral deviance but over half of the secondary enuretics (n = 29) studied showed deviant behaviors at age 7. Fritz and Anderson (1979) found that encopresis and nightmares appeared in secondary enuretics (n = 41) with twice the frequency they were found im primary enuretics (n = 75). Of the secondary enuretics, 81% had experienced at least one major personal or environmental trauma in the month preceding the onset of enuresis (Fritz & Anderson, 1979). Therefore, in the case of the secondary enuretic, behavioral as well as psychological counseling may be required.

In a study the author conducted ("Parent-Child

Directed Nocturnal Enuresis Control By Use of the Buzzer-Pad Method", 1982) with a small population (n = 11) using the standard urine alarm (buzzer-pad method) there were substantial positive results in the elimination of enuresis. An explanation of the procedure was given to the parent(s) and child when they were supplied with the alarm and the author was available for consultation until 14 consecutive dry nights had been achieved.

The subjects were enuretic children between the ages of 3 and 12 with no medically related problem. They were referred or examined by a pediatrician to rule out the possibility of organic urinary disorders that would cause bedwetting.

The apparatus used in this conditioning method was the "Wee Alert Bed-Wetting System" by Sears, Roebuck and Company, U.S.A. This alarm is a very sensitive moisture sensing device which consists of an alarm box (buzzer) with a cord containing two clips which are attached to two foil pads, one solid and one perforated, and an absorbent cloth divider sheet which is placed between the two foil pads. When the child urinates a simple D.C. circuit is completed and the alarm sounds.

The procedure consisted of supplying the referred parent and child with the complete urine alarm system, instruction manual, and a daily progress chart. When the alarm sounded, the parents were to arouse the child, see that the child turned off the alarm, went to the toilet, and became fully awakened and aware of what had transpired. It was advised that the child's face be gently washed with cold water to aid in the complete awakening process.

The progress chart was filled in daily with information such as date, bedtime, time of enuretic episode, amount (large, medium, small, or "beat the buzzer"), comments (hard to awaken, turned off buzzer quickly, slept dry through the night, etc) were recorded along with the child's ability to remember the previous night's episode. The use of the buzzer was discontinued after 14 consecutive dry nights.

Nocturnal enuresis was extinguished in 10 out of the 11 subjects. One subject discontinued use of the procedure because it was difficult for the parent to be consistent. One of the remaining ten subjects in which the enuretic episodes were extinguished regressed after a period of 6 dry months. According to Young and Morgan (1972), statistics available from

1968 indicate that the relapse rate is approximately 30% for patients treated by conditioning methods. The awakening response can usually be quickly re-established if the conditioning method is immediately readministered.

According to parental reports and the author's personal treatment of four of the subjects, the children were extremely difficult to awaken. This was demonstrated by lack of arousal and the child's inability to remember the enuretic episode, buzzer sound, or awakening procedure.

This difficulty in awakening was seen in the initial stages, the first few days, of the conditioning process. The awakening response gradually developed as the process was continually administered and consistently followed. All of the subjects awakened upon hearing the alarm within approximately two weeks and eventually awakened on their own when they felt the urge to urinate, or they slept remaining dry throughout the night.

The ability for some of these children to sleep throughout the night is comparable to the findings of Seiger (1952). He suggested that children, who formerly wet once or more times a night, were able to

sleep throughout the night after conditioning without voiding because they previously urinated before reaching the physiological limit of their bladder. However, some children had to continue to get up and void which may be due to a smaller bladder capacity (Seiger, 1952).

A defective or insufficient feedback inhibition of the bladder could result in two of the phenomena which are most commonly seen in enuresis, namely the decreased bladder capacity and the urgency of micturition (Edvardsen, 1972). Therefore, for the enuretic, if the urge to urinate occurs during the very deepest, "slow-wave" sleep ("Noctural Devils", 1968) then the lack of sufficient feedback inhibition of the bladder would result in the enuretic episode.

There appears to be in the literature no conclusive studies of the relationship betweeen enuresis and heavy sleep (Hallgren, 1957). In fact, Rathke and Jovanovic (1977) found the depth of sleep in 20 enuretic subjects between the ages of 4 and 13.5 years was not different from that of normal children of the same age. Although parents may be more apt to report an enuretic child, whom they have to rouse at night to avoid bed-wetting, as a heavy sleeper, there

is no conclusive evidence that there is a cause and effect relationship between enuresis and deep sleep.

Kales, Kales, Jacobsen, Humphrey, and Soldates (1977) suggested that the positive effects of imipramine in the temporary cessation of the enuretic episodes may be that early in the night when sleep is deepest, imipramine decreases bladder excitability, and/or increases the child's bladder capacity but was not found to effect sleep stages.

This allows the child to continue to sleep without micturition, and, later in the night when sleep is lighter, to be more aware of the stimuli from the bladder. However, as previously stated, the strong possibility of side effects and a high relapse rate of imipramine treatment are significant deterents to its recommended administration.

In order to have long-term positive results, an awakening response when there is stimulation of a distended bladder must be established. Whether the cause of enuresis is due to a smaller bladder capacity or bladder excitability, the stimulation of the bladder may not be a sufficient stimulus to awaken the sleeping enuretic child. Therefore an automatic mechanical arrangement needs to be provided to pair

the awakening response with the sensation of a distended bladder which will result in awakening or becoming aroused sufficiently to contract the urethral sphincter.

It is the author's opinion that enuresis is a problem of an inability to awaken when there is the urge to urinate. Whatever the underlying cause, it appears that the bladder pressure for the persistent nocturnal enuretic is not an adequate stimulus to awaken the sleeper. Ritvo, et al. (1969) found that the nonarousal enuretics had at least one episode of enuresis in stage 2 or 3 - 4 sleep with no evidence of stage shift or arousal signals preceding the wet. This could be construed as evidence that for these episodes no signal of bladder activity reached cortical levels with sufficient intensity to "arouse" the child and thus allow for a choice to take place as to whether he or she should get up, inhibit the reflex while remaining asleep, or wet the bed (Ritvo, et al. 1969).

Through repeated pairing of an alarm (an unconditioned stimulus) set off by urination, the urge to urinate becomes a conditioned stimulus that elicits the response of awakening or prevention or voiding

(Hansen, 1979). Learning theory postulates that bladder control may be regarded as learned behavior, and enuresis as a failure to acquire or maintain appropriate learned responses (Morgan & Young, 1972).

Conditioning is based on the assumption that whatever the causes or influences of the unlearned response, appropriate learning can best be effected by maximizing the impact of the learning situation. In the case of enuresis, the pairing of the awakening response, a previously unlearned response, at the onset of urination by means of an external stimulus, a buzzer/alarm, will create the pairing of urge to urinate and awakening.

Martin and Kubly, (1955) write as follows:

In terms of conditioning theory, bladder tension is the unconditioned stimulus (UCS), and waking up is the response that is to be associated with bladder tension. As time goes by it is also hoped that the somewhat more temporally removed response of sphincter control will become associated with bladder tension, thus allowing the child to sleep through the night dry (Lovibond, 1964).

The conditioning method will thus condition in the enuretic child two separate responses which are

awakening and/or the inhibition of micturation, both in response to the urge to urinate or extended bladder. These responses, repeatedly evoked, eventually supercede that of reflex urination, the learned inhibitory effect of bladder stimulations tending to raise the general tone of the bladder muscle (the detrusur) so that the child not only awakes to urinate, but can eventually sleep for the entire night without either wetting or waking (Morgan & Young, 1972).

Morgan & Young (1972) claimed that the most frequent objection to the elimination of enuresis by means of conditioning methods is concern of symptom substitution. The literature strongly indicates that primary enuresis is not a symptom of an emotional disorder. Silberstein (1973) noticed no relationship between the success of achieving urinary continence and any later symptom substitution or any other type of social or personality maladjustment.

Netley, Khanna, Mckendry, and Lovering (1984) found that children with primary nocturnal enuresis treated with a waking device showed changes in personality throughout the course of treatment. They found in a comparison of two treatment groups, one group with a waking device and the other group with imipramine, the group treated with the waking device

became significantly more extroverted and had lower levels of neuroticism than the group treated with imipramine. Most clinicians testify to improvement in emotional adjustment following relief from enuresis (Morgan & Young, 1972). However, it seems likely that maladjustments could result due to the stress of extended enuresis.

The ability to awaken or become sufficiently aroused appears to be a critical factor in the extinction of the enuretic episodes. The question is raised as to whether enuretic children differ in their ability to awaken as opposed to the non-enuretic child's ability to awaken.

If enuretic children and non-enuretic children show no significant difference in awakening response to an external stimulus, then it can be surmised that the enuretic episodes are not directly related to the enuretic child's lesser ability to awaken. The difference could therefore be due to a lack of internal stimulus which is the urge to urinate or lack of awareness. A significant difference in awakening response could indicate an inability to become aroused sufficiently to either contract the urethral sphincter or to become awakened by the urge to urinate and

therefore empty the bladder in the toilet.

The following study, "Persistent Enuresis and Awakening Response", compares the awakening response of enuretic children and non-enuretic children. Broughton (1968) emphasized the point that enuretic episodes are best considered "disorders of arousal". He concluded that the episodes are essentially disorders of arousal; that the slow-wave sleep arousal episode is a normal cyclic event setting the stage for the episodes; and that the post-arousal confusional state explains the symptom. Using cerebral evoked potentials, Broughton was able to show a "carry over" effect from sleep to arousal, which may account for the reports that enuretic children can be very difficult to rouse (Evans, 1971).

In order for the enuretic child to learn to become sufficiently aroused to prevent micturation, an auxiliary awakening device appears to be necessary. The objective is for the child to associate the urge to urinate with sufficient arousal in order to either inhibit micturation or to awaken and void in the toilet. The buzzer/alarm system is the auxiliary device utilized in this conditioning method.

The following study compares the awakening response of enuretic and non-enuretic children. This awakening response is elicited by an external stimulus, the sound of an enuresis alarm/buzzer.

II Method

Subjects

Apparatus

Procedure

Method

Subjects. The subjects for this study were 38 children between the ages of 5 and 12 years of age. There were 10 primary nocturnal enuretic children and 28 non-enuretic children. These subjects were obtained on a voluntary basis from primary schools, churches, or by randomly asking parents from the general population in Cape Town, South Africa.

Letters were given to parents requesting volunteers for the study. The letter contained information concerning the purpose of the study and the requirements for the testing procedure (see Appendix A for complete derivation).

It was required that the children who were enuretic be primary enuretics which were classified according to the DSM III (1980) criteria as defined on Page 4 in the previous text. All of the enuretic children were incontinent at the time of the study. The children were not undergoing treatment, e.g., receiving medication, etc., at the time of the study.

The non-enuretic children were children who had been continent since the age of four. They were classified as non-enuretic if they had no enuretic episodes or one to two episodes per year after the age of four.

Basic data were collected for each subject with information such as age, sex, frequency of enuretic episodes after age four, whether the child was a primary enuretic or a non-enuretic child, and history of enuresis in the family. This data was collected in the form of a questionnaire. (See Appendix B for complete derivation). Only those enuretic children fulfilling the criteria according to the questionnaire and the DSM III criteria for primary enuresis were tested.

Apparatus. The apparatuses used in this method of testing and measuring awakening response were buzzers very similar to the buzzer/alarm utilized in the "Wee-Alert Bedwetting System" by Sears, Roebuck & Company, and a digital watch containing a stopwatch function. The buzzer was a minature electronic buzzer (75 decibels at 100 centimeters) housed in a metal box with an off-on switch (See Appendix C for

occurs most frequently in that initial period (SREA, 1982).

During this synchronous, slow-wave sleep the brain shows a very large response to outside stimuli such as sounds, but the brain systems that make this stimulation into conscious sensation appear not to be working in their usual way (SREA, 1982). Therefore, the child was required to be able to be aware that the elicited sound was the buzzer and become cognizant enough (aroused) to turn the switch to the off position. Prior to testing the child was allowed to see the buzzer, practice turning the switch off and on, and was told he or she would be tested for three nights but was not told the specific nights. It was necessary for the child to have an advance awareness of the buzzer and their required responses. It was also crucial that he or she not be informed of the specific night prior to the testing.

The buzzer was placed beside the child's bed by the parent exactly two hours after "lights-out". The parent then switched the buzzer to the "on" position and simultaneously began the stopwatch. The

stopwatch was stopped when the child turned off the buzzer or the buzzer sounded for two continuous minutes. The child was required to awaken on his or her own without any parental encouragement and turn the buzzer switch to the "off" position.

The times (duration of awakening response) were recorded for three random nights on a form supplied by the researcher (See Appendix D for complete derivation). The exact time it took the child to become aroused and turn off the buzzer was recorded. If the child did not awaken within 2 minutes, the alarm was switched off and a nonawakening response was noted.

The parents were to record the date of testing, time of child's bedtime, time of testing, duration of buzzer, whether the child remembered the awakening the next day, and parental comments. It was stressed that accuracy in recording was extremely important.

When the parents were supplied with the buzzer the researcher asked the questions that were on the questionnaire. The questions were age, sex, frequency of enuretic episodes after age 4 in order to

classify subjects as enuretic or non-enuretic, and to identify any history of enuresis. These were uniformly asked and marked by the researcher.

Due to the fact that the subjects were aware of the study, the parents were asked to choose random (non-consecutive) nights and spread these over a period of time when necessary, i.e., the child remaining awake in anticipation of the testing. The nights were not to be consecutive nights. This was to decrease the likelihood of a Hawthorne effect.

The parents were also uniformly instructed about the testing procedure and expectations of results were not discussed. The letter of purpose of the study was the explanation given.

The subjects were not differentially selected but both groups, enuretic and non-enuretic, were volunteers. Both groups were identically tested.

The results of the 38 children were divided into the two independent groups, enuretic (n = 10) and non-enuretic (n = 28). A mean awakening time was calculated for each child. A "nonawakening" response was defined by a mean time of one hundred twenty

seconds ($\bar{X}$ = 120) signifying that the subject had no awakening time recorded for the three nights of testing. An "awakening" response was signified by a mean time of less than one hundred twenty seconds for the three nights. Because standard deviation or shape of the population distribution was unknown, a chi-square test for independence was utilized to examine whether there was a significant difference in the awakening response of enuretic children and non-enuretic children. All tests, graphs, and figures were designed according to the specifications outlined in Understanding Social Statistics by Gene M. Lutz.

III Results

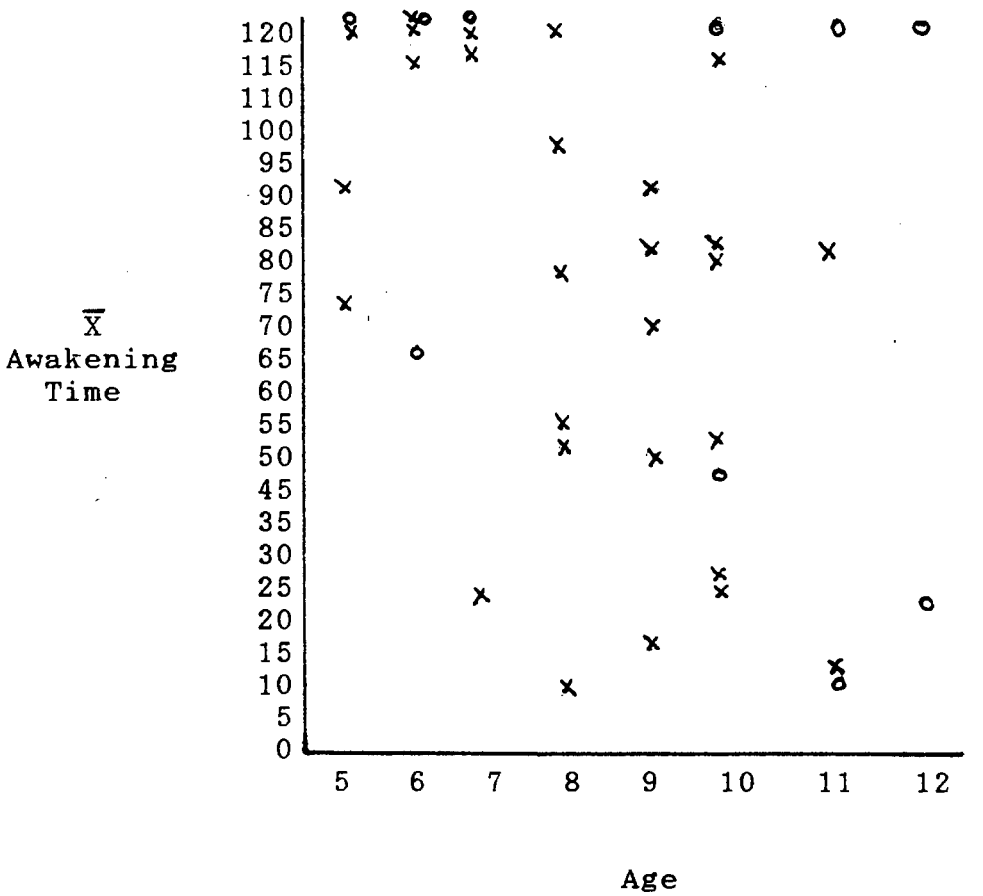
Results

Figure 1 displays the mean awakening time of each subject plotted by age for both groups in the form of a scatter diagram. It can be seen that the younger the child, the longer the awakening response or lack of response. However, three in the older age group of the enuretic subjects also showed a no awakening response. The enuretic group did not show a significant relationship between awakening response and age (X^2 = 1.1) where the non-enuretic group showed a significant relationship (X^2 = 5.2) between age and awakening response. The younger the age the lesser the awakening response. Figure 2 shows the distribution of the mean awakening time for the three nights of testing and ages in the form of a line graph. The skewness can be clearly observed for both groups with a more extreme skewness for the enuretic group. Figure 3 again demonstrates the skewed distribution of both groups by plotting mean awakening times and number of children falling into that particular time category.

In order to measure whether there was a

FIGURE 1

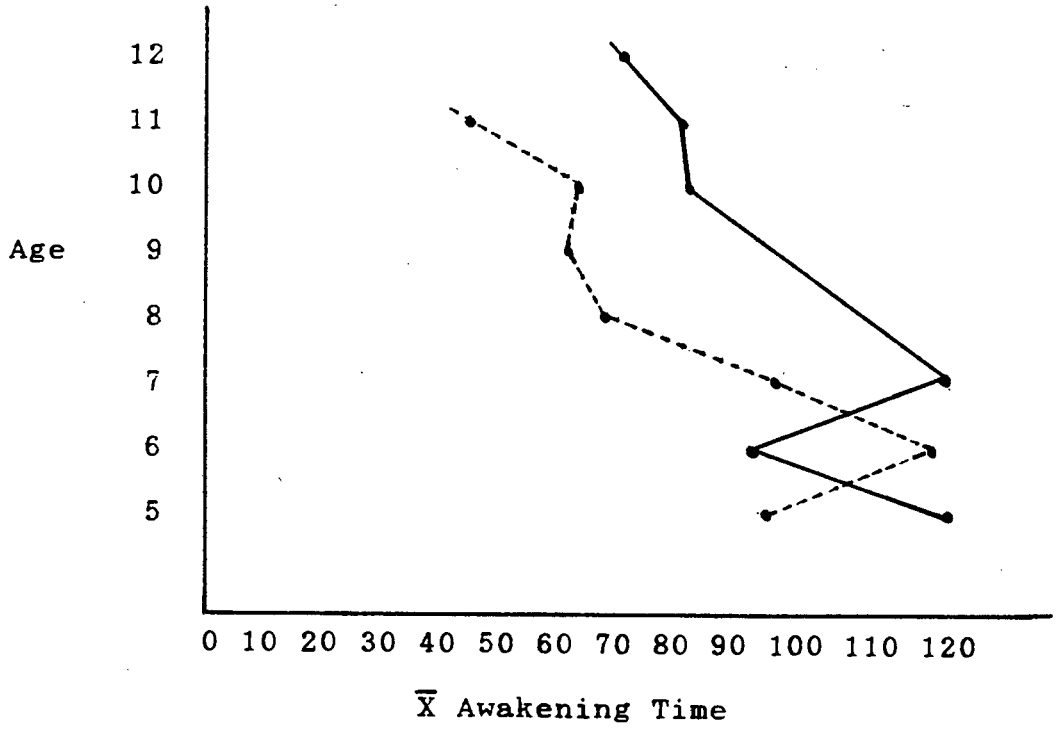
Diagram of Mean Awakening Time by Age of Enuretic and Non-Enuretic Subjects



Mean Awakening Time by Age, Enuretic (n = 10) and Non-Enuretic (n = 28) Subjects, o - Enuretic x - Non-Enuretic

FIGURE 2

Mean Awakening Time By Age of Enuretic and Non-Enuretic Subjects

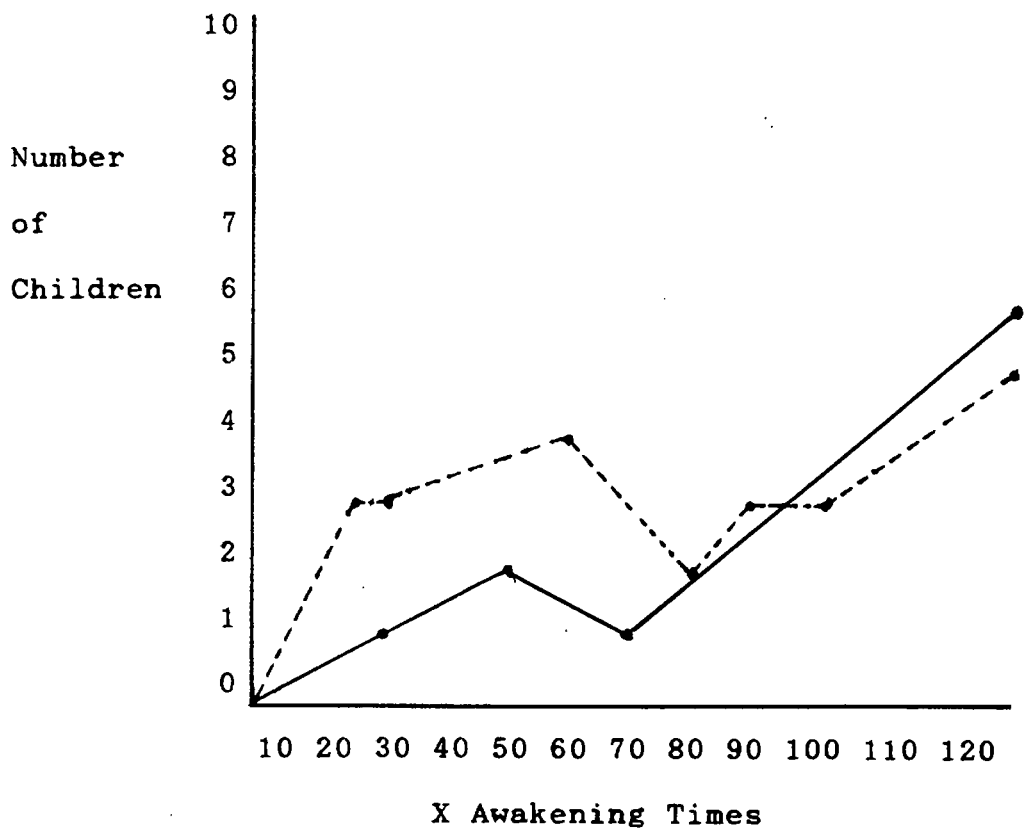


Mean Awakening Time by Age, Enuretic (n = 10) and Non-Enuretic (n = 28) Subjects

___ Enuretic ---- Non-Enuretic

FIGURE 3

Number of Children By Mean Awakening Time



Number of Children by Mean Awakening Time,

Enuretic (n = 10) and Non-Enuretic Subjects

____ Enuretic ---- Non-Enuretic

relationship between awakening response and primary enuresis, a chi-square test was used. The chi-square test was also utlized to examine relationships between age and awakening response within the enuretic group and also within the non-enuretic group and an analysis of relationship of ability to remember awakening and enuresis was examined by comparing the two independent groups, enuretic and non-enuretic. This was done by an examination of the nights the subjects actually awakened, which was defined by an awakening time of less than two minutes, and their ability to remember those awakening events. All tests were performed at the 0.05 level of significance.

Table II shows the frequency of awakening and non-awakening within the enuretic and non-enuretic samples. The chi-square value was 6.4 (X^2 = 6.4) demonstrating a significance at the 0.05 level. Therefore the null hypothesis of no relationship between longer or no awakening response and enuresis was rejected. The degree of association between enuresis and no or longer awakening response was determined by the calculation of Cramer's

TABLE II

Frequency of Awakening and Non-Awakening for Enuretic and Non-Enuretic Subjects

	Awakening	Non-Awakening	Total
Enuretic (n = 10)	4	6	10
Non-Enuretic (n = 28)	23	5	28
Total (n = 38)	27	11	38

Frequency of Awakening and Non-Awakening, Enuretic (n = 10) and Non-Enuretic (n = 28)

$X^2 = 6.4$, df = 1, $p \leq .05$

V = .44

V-statistic. It was found that V = .41 demonstrating an association between enuresis and delayed awakening response.

The mean age of all children tested was 8 years. The groups were then divided into 2 age group categories, those falling below age 8 (n = 19) and those falling above age 9 (n = 19). The relationship between ages within the enuretic and non-enuretic samples and awakening response was examined. The 5 - 8 age group category showed no relationship between enuresis and awakening response as demonstrated in Table III.

The older age group (9 - 12) showed a highly significant relationship between enuresis and lesser awakening ability. The chi-square value was equal to 8.3 with a V-statistic value of .66. This demonstrated a high degree of association between enuresis and a no or longer awakening response and is shown in Table IV. The 2 age groups within the enuretic sample were compared. Table V shows that the relationship between age and awakening and non-awakening is insignificant. The chi-square value

TABLE III

Frequency of Awakening and Non-Awakening Events for Enuretic and Non-Enuretic Subjects, Ages 5 - 8

	Awakening	Non-Awakening	Total
Enuretic (n = 4)	1	3	4
Non-Enuretic (n = 15)	10	5	15
Total (n = 19)	11	8	19

Frequency of Awakening and Non-Awakening, Enuretic (n = 4) and Non-Enuretic (n = 15), Ages 5 - 8

$X^2 = 2.1$, df = 1, $p \leq .05$

TABLE IV

Frequency of Awakening and Non-Awakening Events for Enuretic and Non-Enuretic Subjects, Ages 9 - 12

	Awakening	Non-Awakening	Total
Enuretic (n = 6)	3	3	6
Non-Enuretic (n = 13)	13	0	13
Total (n = 19)	16	3	19

Frequency of Awakening and Non-Awakening, Enuretic (n = 6) and Non-Enuretic (n = 13), Ages 9 - 12

$X^2 = 8.3$, df = 1, $p \leq .05$

V = .66

TABLE V

Frequency of Awakening and Non-Awakening Events for Enuretic Subjects, Ages 5 - 8 and Ages 9 - 12

	Awakening	Non-Awakening	Total
Enuretic Age 5 - 8 (n = 4)	1	3	4
Enuretic Age 9 - 12 (n = 6)	3	3	6
Total	4	6	10

Frequency of Awakening and Non-Awakening, Enuretic Ages 5 - 8 (n = 4) and Enuretic Ages 9 - 12 (n = 6)

$X^2 = 1.1$, df = 1, $p \leq .05$

was equal to 1.1 indicating no relationship in age of the enuretic child and ability to awaken.

However, the relationship between age and awakening and non-awakening in the non-enuretic sample was significant as demonstrated in Table VI. The chi-square value was 5.2 with a V-statistic value of .43 indicating a positive association.

Table VII demonstrates the relationship between enuresis and ability to remember the awakening event. This was tabulated according to the total number of nights that the children awakened and whether they remembered the event. There were 55 total awakening nights for both groups. There was no relationship found between enuresis and ability to remember the awakening events.

Figure 4 displays awakening times in seconds for the three nights of testing for the awakening enuretic children. There were 4 enuretic children who recorded a mean awakening time of less than 120 seconds. The figure displays the time in seconds plotted by nights tested in order to examine any conditioning effect. Two of the 4 awakening enuretic children awakened all three nights and the other 2

TABLE VI

Frequency of Awakening and Non-Awakening Events for Non-Enuretic Subjects, Ages 5 - 8 and Ages 9 - 12

	Awakening	Non-Awakening	Total
Non-Enuretic Age 5 - 8 (n = 15)	10	5	15
Non-Enuretic Age 9 - 12 (n = 13_	13	0	13
Total	23	5	28

Frequency of Awakening and Non-Awakening, Non-Enuretic Ages 5 - 8 (n = 15) and Non-Enuretic Ages 9 - 12 (n = 13)

$X^2 = 5.2$, df = 1, $p \leq .05$

V = .43

TABLE VII

Frequency of Nights Awakened and Ability to Remember the Awakening Response for Awakening Enuretic and Non-Enuretic Subjects

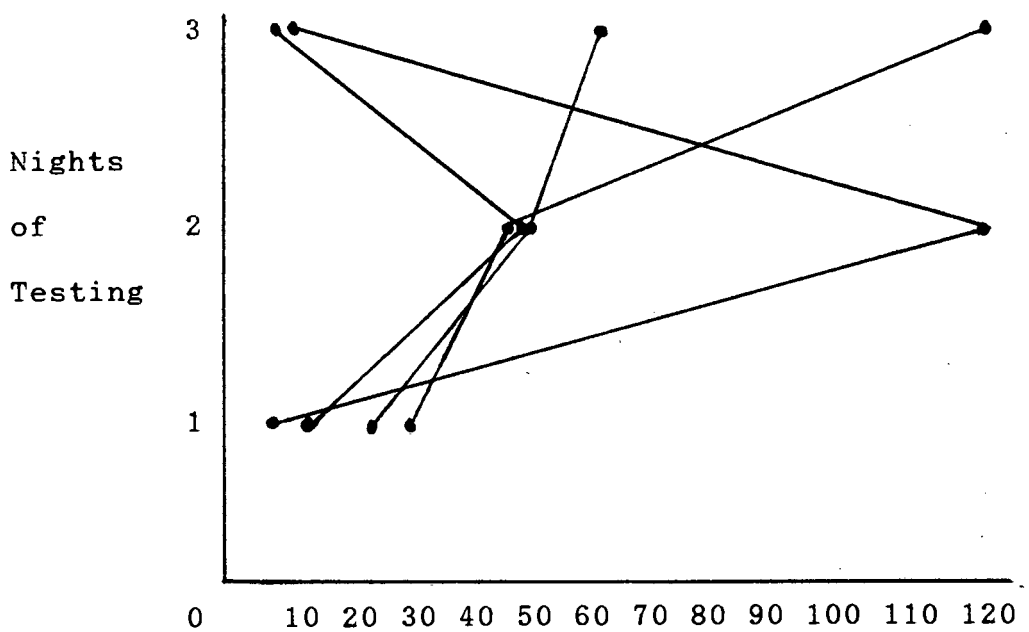
	Remembered	Not Remembered	Total
Enuretic (n = 10)	6	4	10
Non-Enuretic (n = 45)	26	19	45
Total (n = 55)	32	23	55

Frequency of Nights Awakened and Ability to Remember Awakening Response, Enuretic (n = 10) and Non-Enuretic (n = 15)

$X^2 = 2.2$, df = 1, $p \leq .05$

Figure 4

Awakening Time of the Three Nights of Testing For Awakening Enuretics



Awakening Time in Seconds by Night of Testing, Awakening Enuretics (n = 4)

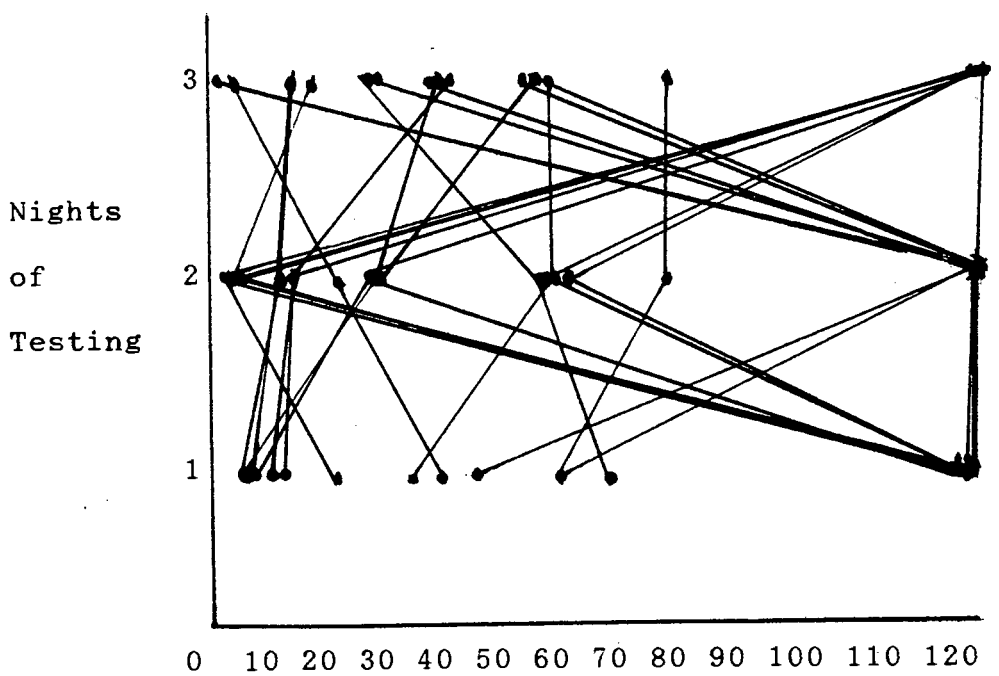
awakening enuretic children awakened two of the three nights.

Figure 5 displays awakening time in seconds for the three nights of testing of 23 non-enuretic children who recorded a mean awakening time of less than 120 seconds. Nine of these subjects awakened all three nights, and 10 awakened one of the three nights of testing.

Table VIII displays the frequency of awakening nights for the 27 awakening subjects, enuretic and non-enuretic. There was a total of 56 awakening nights. The table indicates that the awakening nights were distributed with 17 awakenings in Night 1, 20 awakening in Night 2, and 19 awakenings in Night 3. Table IX displays the frequency of awakening nights for the awakening enuretic subjects. There was a total of 10 awakening nights with an almost even distribution of 4 awakenings in Night 1, 3 awakenings in Night 2, and 3 awakenings in Night 3. Table X displays the frequency of awakening nights in Nights 1 - 3 for the 23 non-enuretic awakening subjects. These subjects had a total of 46 awakening nights.,

Figure 5

Awakening Time of the Three Nights of Testing for Awakening Non-Enuretics



Awakening Time in Seconds by Night of Testing, Awakening Non-Enuretics (n = 23)

TABLE VIII

Frequency of Awakening Nights for Three Nights of Testing of the Twenty-Seven Awakening Subjects, Enuretic and Non Enuretic

	Frequency of Awakening Nights
Night 1	17
Night 2	20
Night 3	19
Total Awakening Nights (n = 56)	

TABLE IX

Frequency of Awakening Nights for Three Nights of Testing of the Four Enuretic Awakening Subjects

	Frequency of Awakening Nights
Night 1	4
Night 2	3
Night 3	3
Total Awakening Nights of Enuretic Subjects (n = 10)	

TABLE X

Frequency of Awakening Nights for Three Nights of Testing of the Twenty-Three Non-Enuretic Awakening Subjects

	Frequency of Awakening Nights
Night 1	13
Night 2	17
Night 3	16
Total Awakening Nights of Non-Enuretic Subjects (n = 46)	

The distribution, as indicated by the table is 13 awakening nights in Night 1, 17 awakening nights in night 2, and 16 awakening nights in Night 3.

The sex variable of the questionnaire indicated that there were a total of 17 female subjects and 21 male subjects. These were divided into the two categories, enuretic and non-enuretic, and showed 6 male enuretic subjects, 4 female enuretic subjects, 15 male non-enuretic subjects, and 13 female non-enuretic subjects. The male and female variable was relatively evenly represented in the study.

There were 3 male enuretic subjects that showed an awakening response and 3 that did not awaken. One of the female enuretic subjects showed an awakening response and three showed a no-awakening response. There were 13 male non-enuretic subjects that awakened and 2 that did not show an awakening response. Ten of the non-enuretic females awakened and 3 did not awaken. It should be noted that the 2 non-enuretic males and 3 non-enuretic females that did not awaken fell into the 5 - 8 age group category. The ages for the 6 female and male enuretic subjects that did not

awaken were distributed throughout the 5 - 12 age group category (Female - ages 5, 6, 10; Male - ages 7, 11, 12). This is consistent with the previous findings in Table VI which indicates a strong relationship between age and awakening in the non-enuretic sample and Table V that demonstrates no significant relationship between age and awakening in the enuretic sample.

The parents reported a history of enuresis, as specified in the questionnaire, in seven of the 10 enuretic cases (70%). The other three were uncertain. The parents of the non-enuretic subjects reported no history in 22 of the 28 cases. The six who had a reported history were siblings of six of the enuretic subjects.

IV Discussion

Discussion

Enuretic children and non-enuretic children showed a significant difference in ability to awaken indicating that enuretic children have a lesser ability to awaken. This lesser ability to awaken along with the possibility of smaller bladder capacity, bladder excitability, or insufficent stimulus from the bladder as indicated by the literature is relevant to the understanding and treatment of enuresis.

The overall positive finding of a strong relationship between age and a lesser awakening ability is consistent with the literature. Deep stage sleep makes up 20% to 25% of total sleep in most young children and the percent of deep sleep decreases to 10% of total sleep by adult life (Ablon and Mack, 1979). Therefore the older the subject the lesser the percentage of stage 3 and stage 4 NREM sleep. This slow-wave sleep appears the least amenable to awakening therefore the younger child with a greater proportion of slow-wave sleep would possibly

demonstrate a lesser awakening ability. In a number of experiments demonstrating that people can make responses such as pressing a button during sleep, the response more rarely occurred during slow-wave sleep of stages 3 and 4 (SREA, 1982).

As previously indicated, slow-wave sleep occupies a goodly proportion of the initial part of the night. Kales and Kales (1974) stated in a typical night of sleep there is initially a brief period of stages 1 and 2 followed by a lengthier interval of stages 3 and 4 sleep lasting approximately 70 to 100 minutes. A REM period occurs and the cycle is repeated at 90-minute intervals throughout the night. The two hour period from "lights-out" until sleep may have allowed a sufficient time for the younger child to lapse into the slow-wave period of sleep where the older child, due to a lesser percentage of slow-wave sleep, may have already moved out of NREM phase. About an hour or so after falling asleep, the sleeper may begin to drift into the lighter phase of sleep (Demott & Kleitman, 1957).

A difference in age and ability to awaken was

clearly demonstrated in the non-enuretic group, however the enuretic group showed no significant relationship between awakening response and age. In other words, the older enuretic child was as likely to have a lesser awakening ability as the younger enuretic child. Some children may have central nervous system (CNS) immaturity, which may be a genetically determined predisposition (Simonds & Parraga, 1982). This coincides with the etiological concept of a maturational lag concerning arousal ability with the historical prevalence of enuresis. Simonds and Parraga (1982) stated as the percent of deep sleep decreases, there may be changes in CNS maturation and a diminished frequency of enuresis.

Pierce et al. (1961) claimed that enuretic episodes most commonly occur during stage 4 NREM sleep. The awakening response is also least likely to be elicited during this phase. This stage of sleep is called the most oblivious sleep (SREA, 1982) when the muscles are very relaxed and the person rarely moves. According to the findings of this study, the older non-enuretic child appears to have

possibly progressed out of the deep sleep stage and has resumed the pattern of stage 2 when according to Sleep and Dream Research, (SREA, 1982), the child is quite soundly asleep but not hard to awaken. In this phase, it will take a relatively huge amount of noise to awaken a person - yet a very slight noise with significance, may quickly alert him (Goodenough, 1963). The buzzer may be that significant stimulus since the child had previously been made aware of its impending occurrence. In other words, the child may have become tuned into the buzzer as an adult is prepared to awaken to his morning alarm clock.

The anticipation of testing coupled with a lesser percentage of Stage 3 and 4 sleep could account for the greater awakening ability of the older non-enuretic child. It can be assumed that the younger non-enuretic child has not progressed out of Stage 4 sleep due to the maturational aspect which indicates a higher percentage of Stage 4 sleep in younger children. According to Sleep and Dream Research, (SREA, 1982), approximately 90 minutes elapse before the sleeper returns to Stage 2. The

two hour period from "lights out" until testing may have given the older child sufficient time to have progressed to a phase where the awakening response is more likely but not sufficient time for the younger child to have returned to Stage 2. This predisposition in younger age children in whom deep sleep stages predominate may be manifested by paraxysmal irregularities in arousal state (Simonds & Parraga, 1982).

The results indicate that there is no significant difference in awakening ability and age in the enuretic sample. This is indicative of a strong possibility of a maturational delay as indicated in the literature. It appears that the older child with enuresis may have central nervous system (CNS) immaturity as indicated by Simonds and Parraga, 1982). Unlike the older non-enuretic child who may have a lesser percentage of deep sleep, the older enuretic child may not differ from the younger enuretic or non-enuretic child in percentage of deep sleep. Rutter (1965) stated that the pronounced age-incidence curve provided a strong case for

classifying enuresis as a developmental disorder.

The results however indicated no significant difference in awakening ability in the enuretic and non-enuretic ages 5 - 8 sample. Because it is evident that not all 5 - 8 year old children are enuretic, it must be assumed that other factors contribute to the enuretic episodes other than the inability to awaken. There is ample evidence that enuretic children have smaller bladder capacities than non-enuretic children their age (Harris & Purohit, 1977). This possibility considered with a higher percentage of deep sleep in the younger child and lesser awakening ability could set the stage for the enuretic episode.

The smaller bladder capacity and maturational delay could also explain the perpetuation of enuresis in the older enuretic child. The habit may cease at any time during childhood - often 6 to 8 years - but it generally continues until the early teens when it ordinarily corrects itself (Bakwin, 1961). This self-correction could be due to a development of a lesser percentage of Stages 3 and 4 sleep therefore

enhancing the awakening ability or the ability to become sufficiently aroused to inhibit micturation.

Another aspect analyzed was the ability of the children to remember the awakening event. The results indicated no difference in the non-enuretic child's ability to remember the awakening event as opposed to the enuretic child's ability to remember. Sleep and Dream Research, (SREA, 1982) reported a study similar to the recall aspect of this study in that subjects were awakened, presented with a word, and asked to recall the word the following morning. Retention, it would seem, depends upon how soon the person receiving the word goes back to sleep (SREA, 1982). If permitted to fall asleep almost directly, the subject appears to forget - suggesting that sleep, itself, can prevent the forming of a memory (SREA, 1982). The parental feedback indicated that the children involved in the testing immediately resumed sleep if awakened. There were no reports of disturbance of sleep.

The analysis of a conditioning or learning

effect indicated that no learning took place over the three nights of testing. The awakening nights were fairly evenly distributed with only one additional awakening night occurring in Night 2 for the total group of 27 awakening subjects. This distribution also indicates that there was not an anticipation or experimenter effect due to the fact that the least amount of awakening nights for the total group occurred in Night 1.

The analysis of a relationship between sex and awakening indicated no significant relationship between the awakening response and sex of the child. Although Hallgren (1957) found a significantly higher morbidity risk for nocturnal enuresis among boys, the present study did not indicate a difference in awakening response and sex. However, a significant relationship between age and awakening was indicated. This was demonstrated by the fact that the 5 male and female non-enuretic children that did not awaken were in the 5 - 8 age group category. Future analysis of sex and awakening response over larger samples might yield more significant results.

The fairly high incidence of familial history of enuresis found in this study is also consistent with the literature. It is an old observation that enuresis is a family disorder, occurring with high frequency in the parents, siblings, and other near relatives of patients (Bakwin, 1961). However, many parents are reluctant to admit that they were bed-wetters in childhood. A common reply to the question: "Did you have this trouble when you were a child?" or "At what age did you stop wetting the bed?" is, "I don't remember," or "I'll have to ask my mother." (Bakwin, 1961). The three parents of the enuretic children who were uncertain of family history gave similar responses.

Bakwin (1961) found a high incidence of enuresis during childhood among 50 parents, 25 families, of children with enuresis. He claimed that there was a strong indication of a hereditary basis for enuresis. A genetic base for CNS immaturity was also suggested by Simonds and Parraga (1982). Therefore, an inherited maturational delay as well as a small bladder capacity are highly probable.

The unreliability of parental testing and reporting is a consideration in the analysis of the results in that there could be miscalculations or inefficiency of recording. Although parents were uniformly questioned and simple testing and recording procedures were required, the possibility of experimenter effects or a Hawthorne effect exists, even though the analysis did not indicate a conditioning effect or experimenter effect. It must also be considered that the child's response to remembering the awakening incidence could have been influenced by a desire of the parent to give what may have been considered positive results. However, only 5 of the 38 children reported remembering for all 3 nights of testing.

The significance of lesser awakening ability of the enuretics in this study could contribute substantially to the understanding of enuresis. However, caution must be taken due to the small sample sizes. Future testing with larger samples of enuretic and non-enuretic children could yield more significant results relating to the difference in awakening response.

The results of this study clearly indicate a difference in awakening ability in enuretics and non-enuretics and a relationship to age and awakening response. The insignificant difference between younger and older enuretic children indicates a possible maturational delay of progressing out of the Stages 3 and 4 sleep into a stage of sleep that would be more conducive to awakening when there is the urge to urinate. Future study comparing the percentages of slow-wave, Stage 3 and 4, sleep of older enuretic and non-enuretic children could yield beneficial information concerning a possible maturational lag of the older enuretic child.

Unfortunately, the knowledge that the enuretic child will "mature to continence" is of little comfort to the parent(s) and child. What is needed is a form of treatment which offers a high probability of achieving continence without harmful side effects.

Theoretically it should be easy to treat a bedwetter by setting an alarm clock at intervals during the night - but it is well known that this does

not work; the alarm sounds, awakens everyone else in the family, but the patient sleeps on and wets the bed (Warwick & Whiteside, 1979). The study "Parent-Child Directed Nocturnal Enuresis Control By Use of the Buzzer-Pad Method" (1982) also demonstrated the difficulty of the child to initially respond to the sound of a buzzer. It was necessary that the parent(s) get the child to fully awaken and turn off the buzzer in order for appropriate training to be established. It is hardly surprising that the enuretic child fails to be awakened by his or her bladder.

Additional study of the awakening response of enuretics in the area of what type of stimulus would be necessary to awaken the child could be of great benefit toward treatments and development of more efficient methods. For example, the buzzer alone in the conditioning method may not be a sufficient stimulus to awaken the child. In the study by the author, "Parent-Child Directed Nocturnal Enuresis Control By the Use of the Buzzer-Pad Method", the

children did not initially (first week to two weeks) respond to the sound of the buzzer but had to be aroused by the parent. The majority of parents in the study (11 cases) reported that awakening the child was a lengthy and difficult process. There would possibly be no conditioning between urge to urinate and awakening if the child was not first aroused by the parent. The buzzer would continue to sound long past the enuretic response and the required pairing of awakening and urge to urinate would fail to take place.

Because there appears to be the component of inability to awaken as well as bladder function, the evaluation of various forms of treatment is important. The successful eradication of enuresis does not appear to be solely the result of improvement of bladder function.

In the study by Harris and Purohit (1977) bladder training was tested as a treatment for enuresis. They exposed 18 enuretic subjects to a 35 day bladder training procedure. The results showed

that the training produced sizeable changes in bladder capacity but proved ineffective in reducing enuresis. The results of this investigation along with those of Rocklin and Tilker (1973) and Doleys et al. (1975, 1977) cast serious doubt on the efficacy of a bladder training regimen used alone in the treatment of enuresis (Turner, Young, and Rachman, 1970). This lack of success could be due to the lack of treatment in the area of awakening.

The use of imipramine has been successful in the treatment of enuresis possibly because impramine has been found to increase Stage 2 sleep as found by Kales et al. (1977). Several explanations have been proposed as to why imipramine is often successful. Miller, Champelli, and Dinello (1968) states as follows:

1. The best substantiated action is that it is a cholinergic blocking agent. It opposes the action of the parasympathetic division of the autonomic nervous system which relaxes the sphincter muscle of the urinary bladder. Therefore, it might block reflex urination as a spinal cord action.

2. It is a mild cerebral stimulant which might block the deepest level of sleep. If enuresis occurs only in deep sleep, as some maintain, then imipramine might block this. (Miller et al., 1968).
Although imipramine may offer a more immediate cessation of enuresis, the relapse rate and side effects indicated in the literature are great. Kales et al. (1977) stated, "Since we do not know the long-term effects of administering imipramine to young children, we do not recommend the use of imipramine in these children".

It appears according to the literature that the safest and most successful method for the treatment of enuresis is the conditioning method. Even though the conditioning method is successful in bringing about the initial arrest of nocturnal enuresis there is according to Lovibond (1964) an approximate 34% relapse rate. The possible reason for relapse with the conditioning method is that although the pairing of urge to urinate with awakening is established, the simple conditioning in itself is not sufficient to bring about a long-term cure in some cases.

Overlearning as discussed by Morgan and Young (1972) and/or a positive reinforcement program appears to add to the long-term conditioning effect. While certain modifications of the conditioning process such as adjuvant drug therapy or twin-signal apparatus may shorten the conditioning period, they may result in a higher relapse rate due to insufficient learning. Turner, Young, and Rachman (1970) stated it is more important to bring about stable learning than to develop modification which may hasten the conditioning process (e.g. adjuvant drug therapy or twin-signal apparatus).

A possible explanation as to the initial success of the conditioning method is that the awareness of urge to urinate is established by the subject becoming aroused sufficiently while the urge is present. The author found no evidence that conditioning alters sleep stages but according to Sleep and Dream Research, (SREA, 1982) sleep studies indicate that subjects can discriminate sounds during all phases of sleep. It was found that whenever a critical tone

was sounded, the EEG patterns shifted toward the characteristic fast rythms of arousal (SREA, 1982). This was caused by pairing a critical tone with a mild shock. Therefore the conditioning method used in enuresis pairs the urge to urinate with the sound of a buzzer which has been paired with awakening by the parents' arousal of the child. Once the buzzer has been sufficiently paired with arousal it can cause a shift from deep sleep to a lighter sleep phase to arousal. This pairing eventually results in arousal from the primary stimulus of urge to urinate alone. As explained previously, this could result in the child becoming sufficiently aroused to inhibit micturation or to void in the toilet. Future study exploring the effect of conditioning on the enuretic child, who may be in a maturational lag, could yield beneficial information. By measuring EEG patterns before and after conditioning, it could be assessed if conditioning helps the child decrease a possible larger percentage of Stages 3 and 4 sleep thus enhancing awakening ability. The enuretic child

being conditioned to awaken could be much like the child with a reading disability being taught to read with remedial instruction.

The initial success of continence can be more firmly established by a supplemental positive reinforcement program and/or overlearning. Learning theory has provided a systematic rationale for the treatment of nocturnal enuresis and it continues to suggest ways of improving treatment, e.g., use of partial reinforcement effect to reduce relapse (Turner, Young, & Rachman, 1970).

Although behavioral conditioning with a urine alarm appears to be the treatment of choice for primary nocturnal enuretic children, the importance of parental cooperation to treatment success cannot be minimized (Wagner et al., 1982). Geppert (1953) found that the chief cause of failures unquestionably was poor parental cooperation.

It is unlikely that there is a quick as well as long-term cure for enuresis unless it occurs due to spontaneous remission. Most children become dry

without any formal therapy ("Child Psychiatry and Enuresis", 1981). Approximately one in six of enuretic children dry up every year from age five to age fifteen without treatment (Forsythe and Redmond, 1974). However, as previously stated, this is of little consolation to the parent(s) and child dealing with wet sheets and the emotional trauma that can be caused by prolonged enuresis.

The information found in this study has been consistent with previous research findings and reinforces the concept that establishing an awakening response is necessary in the elimination of enuresis. Further developments of effective treatments without harmful side effects dealing with learning to awaken when there is the urge to urinate are warranted. Methods that teach the child to control the enuretic response would greatly aid in the elimination of the emotional trauma that is often much a part of enuresis. George Orwell, who suffered from childhood enuresis stated:

I knew that bed-wetting was (a) wicked and (b) outside my control. The second fact I was personally

aware of, and the first I did not question. It was possible, therefore, to commit a sin without knowing you committed it, without wanting to commit it, and without being able to avoid it (Broughton, 1968).

There are presently effective conditioning methods available that teach the child the awareness leading to control. However the continual investigation of more rapid, long-term methods are necessary. Enuresis prevalence may continue in the pediatric community but further investigations leading to more effective methods will hopefully lead to early cessation of the problem. Until a more effective method is developed and proven, the conditioning method should be promulgated as being the most effective and least harmful of all methods for treating nocturnal enuresis.

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VI Appendices

Appendix A

Dear Parents,

"Persistent Enuresis (bedwetting) and Awakening Response", is a research study I am conducting in partial fulfillment for my Masters Degree in Clinical Social Work at the University of Cape Town. I have worked with bedwetters in the United States and have done a considerable amount of review of the literature. According to my literature review and experience I have found that bedwetters have an inability to awaken when they have the urge to urinate thus resulting in the bedwetting episode.

This study involves the testing of awakening response of children between the ages of five and twelve. It in no way indicates the intelligence or psychological adjustment of your child. The testing is simply a measurement of the amount of time it takes your child to awaken during one of the deep sleep phases which is approximately one to two hours after the child falls asleep. The accuracy of recording is of vital importance to the outcome of the study. Comparisons will be made between enuretic (bedwetting) children

Appendix A (continued)

and non-enuretic children. The question being researched is whether enuretic children differ in their ability to awaken than non-enuretic children. The results could be very helpful for the future treatment of enuresis.

I would greatly appreciate volunteers for this study which would involve three random nights of testing. Thus far, there have been no problems of disturbance of sleep in the children that have participated.

I have enclosed instructions explaining what would be required of parent and child.

Testing will be done on enuretic and non-enuretic children. All information will be confidential.

Thank you for your assistance.

Sincerely,

Carla Crews

Social Worker - Student-Masters in Clinical Social Work

Appendix A (continued)

Instructions:

You will be shown the mechanical use of the buzzer and stopwatch by verbal instruction.

Turn on the buzzer two hours after the child's bedtime, e.g., if your child goes to bed at 8:00 you turn on the buzzer at 10:00. It is extremely important to have an exact two hour period from bedtime (lights out) to sounding the buzzer. Turn on the buzzer and at the same time begin the stopwatch to time the duration of the buzzer.

The stopwatch is stopped when your child turns off the buzzer or the buzzer sounds for two continuous minutes. The times are to be recorded for three random nights on a form supplied by the researcher. Accuracy in recording is extremely important.

The child should be able to resume normal sleep after the brief awakening. The child must awaken on his or her own without any parental encouragement.

Appendix B

Case Information:

Case Number _____ Age _____

Date _____

Sex Male _____ Female _____

Frequency of enuretic episodes after age four :

_____ never (no enuretic episodes)

_____ rarely (one to two episodes per year)

_____ seldom (one to two times per month)

_____ occasionally (two to three times per week)

_____ often (approximately every night)

Classification:

_____ non-enuretic (never to rarely)

_____ primary enuretic (no period of night time continence

_____ secondary enuretic (enuretic episodes with a previous period of at least twelve months of continence/dryness)

Number of Siblings _____

Enuretic Siblings (Number, Ages) _____

Non-Enuretic Siblings (Number, Ages) _____

Appendix B (continued)

History:

_____ Mother was enuretic

_____ Father was enuretic

_____ Paternal Aunt was enuretic

_____ Paternal Uncle was enuretic

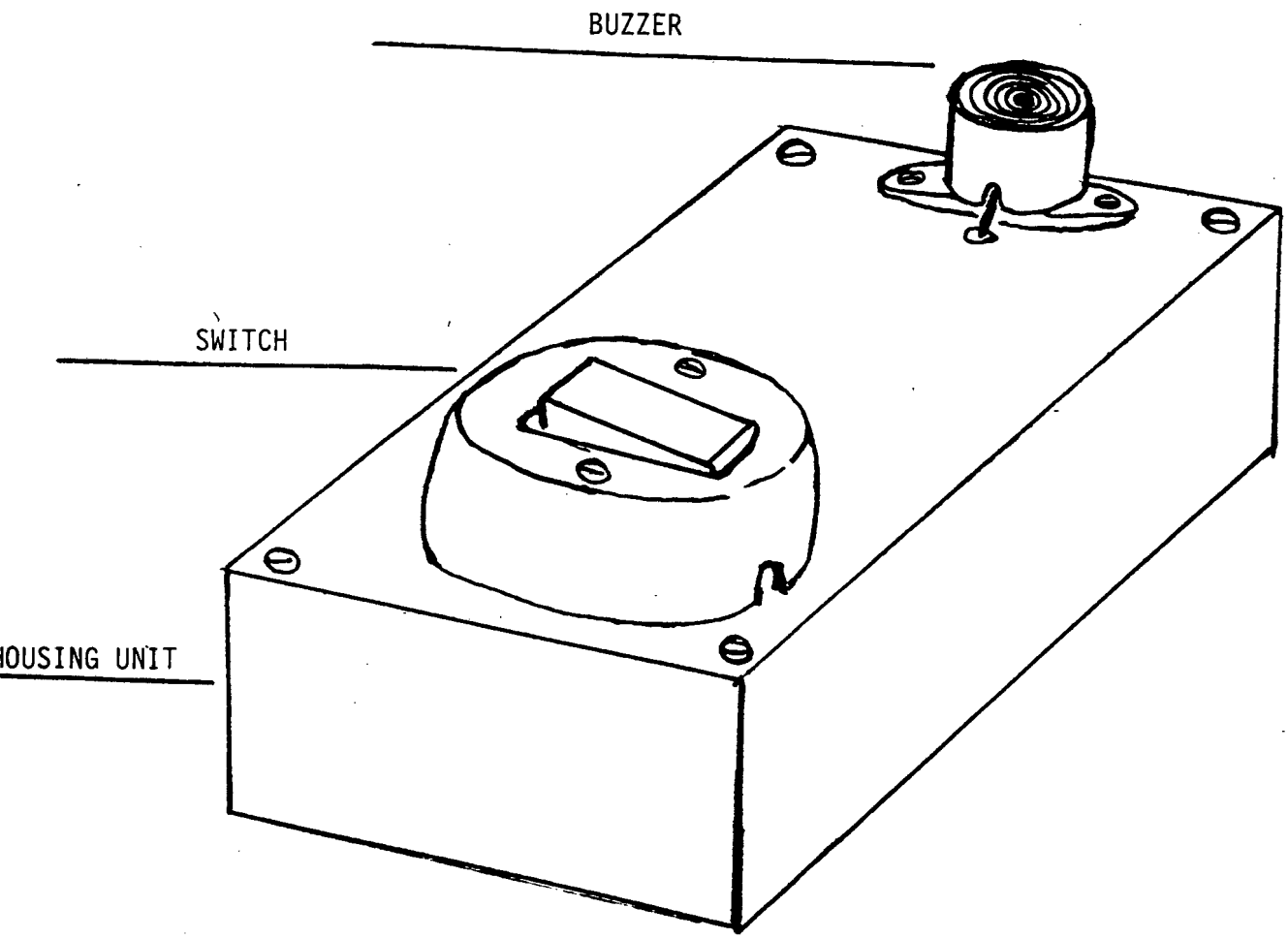
_____ Maternal Aunt was enuretic

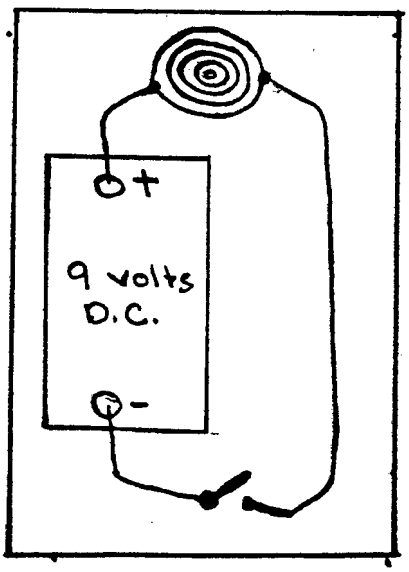
_____ Maternal Uncle was enuretic

_____ Paternal Grandparent was enuretic

_____ Maternal Grandparent was enuretic

APPENDIX C





CIRCUIT SCHEMATIC

Appendix D

Recording Form: Case Number _____

Date	Time Child Goes to Bed	Time Buzzer was Turned On

Duration of Buzzer	Child Remembers the Next Day (Yes or No)

Comments _____