1976

Individual differences in imaging behavior: vividness and controllability

Joseph Ellsworth Switras
Iowa State University

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1975
Individual differences in imaging behavior:
Vividness and controllability

by

Joseph Ellsworth Switras

A Dissertation Submitted to the
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Table of Contents

Chapter I. Introduction 1
What is Mental Imagery? 4

Chapter II. Literature Review 8
Historical Background 8
Imagery in Counseling/Psychotherapy and Psychopathology 10
General Experimental Imagery Research 14
Theories of Imagery 17
Imaging and the Sensory Modalities 22
Vividness and Controllability 23
Individual Differences in Imaging 24
Measuring Mental Images 28

Chapter III. Method 33
Subjects 33
Tests and Materials 33
Procedure 35

Chapter IV. Results 44

Chapter V. Discussion 60
Implications 62

References 71
Acknowledgments 87
Appendix. Form A and Form B 88
| Figure 1. Data analysis matrix | 40 |
List of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cronbach Alphas for Subtests and Total Scores: Diagonal A</td>
<td>45</td>
</tr>
<tr>
<td>2.</td>
<td>Parallel Form Reliability: Diagonal B</td>
<td>46</td>
</tr>
<tr>
<td>3.</td>
<td>Intercorrelations of Subscales of Form A</td>
<td>47</td>
</tr>
<tr>
<td>4.</td>
<td>Intercorrelations of Subscales of Form B</td>
<td>48</td>
</tr>
<tr>
<td>5.</td>
<td>Cross-Correlations of Form A and Form B</td>
<td>49</td>
</tr>
<tr>
<td>6.</td>
<td>Factor Analysis of Form A and Form B Subtests</td>
<td>51</td>
</tr>
<tr>
<td>7.</td>
<td>The Betts QMI and the Gordon Test of Visual Imagery Control Correlated by Sex with the ACV, AVV, BCV, and BVV</td>
<td>53</td>
</tr>
<tr>
<td>8.</td>
<td>Visual Validity Coefficients</td>
<td>54</td>
</tr>
<tr>
<td>9.</td>
<td>Miscellaneous Validity Coefficients</td>
<td>55</td>
</tr>
<tr>
<td>10.</td>
<td>Normative Data by Test Form and Sex</td>
<td>58</td>
</tr>
</tbody>
</table>
Chapter I.

Introduction

Mental images were first systematically researched at the end of the nineteenth century by Sir Francis Galton (1880, 1883, 1907 as cited in Lindauer, 1972; McKellar, 1972). Though the area of imagery attracted much interest in the early days of psychology, there has not been much systematic study during the last 50 years. This neglect has occurred despite the fact that mental images are a common, wide-spread phenomenon (Bugelski, 1971; Freud, 1900; Hannay, 1971; Horowitz, 1970; Lewin, 1968; Paivio, 1971a, 1971b; Piaget, 1930; Pylyshyn, 1973; Segal, 1971; Sheehan, 1972b; Singer, 1966). Though neglected in the laboratory, clinician/research psychologists have found mental images to be useful in personality assessment and behavior change. Most previous imagery research has been based on a myriad of improvised and basically substandard assessment devices. Hence, the purpose of this study was to construct an alternate-form test instrument of high psychometric quality for the assessment of individual differences in imaging behavior. If such a device can be constructed, it would provide objective data about one of man's most private, controversial, and elusive behaviors.

Daydreaming (the major ingredients being mental images) is also a phenomenon that most people have probably experienced (Singer, 1966). Singer and McCraven (1961) report that about 96% of the people they interviewed had daily daydreams in which visual imagery was the major sensory mode. They found that people could describe fairly clear images of objects and events, as well as people. Singer (1966) suggests that because daydreams
(therefore images) are such common events in our lives, they are hardly ever considered as a research topic. He feels that the widespread nature of imagery is the very reason that it warrants study. Historically, both imagery and daydreams appear to have been neglected by psychologists.

Very recently, after nearly 50 years of somewhat fanatical avoidance, mental imagery has returned to a position of prominence in many areas of psychology. The scientific literature abounds with arguments for the status of mental images as both possible and desirable material for scientific psychological study. Numerous papers are calling for more research (e.g., Day, 1969; Kessel, 1972; McGlynn & Gordon, 1973; McGlynn, Hofius, & Watulak, 1974; Pylyshyn, 1973; Singer, 1969). In his major philosophical paper and review of research, Pylyshyn (1973) notes that imagery has not just reappeared as an object to be studied. In cognitive psychology, it is being productively employed as an explanatory construct. Pylyshyn feels that any discussion of consciousness cannot avoid the simultaneous implication of the existence of mental images. Other researchers (Kessel, 1972; Meissner, 1966; Zener, 1958; Zener & Graffon, 1962) have seriously questioned the claim that imagery is subjective and not available to scientific scrutiny by asserting that scientific objectivity seeks repeatable events under specifiable and manipulable conditions. Therefore, if different people claim to experience similar images under specifiable conditions, the self-report of images can be objectively studied. In support of this notion, Zener and Graffon (1962) state that, "if experience is accepted as a reality, and if the universe is accepted as orderly, then to the extent that relevant conditions ... are similar, the experiences of two comparable individuals under similar conditions should be similar" (p. 557).
An argument against the study of imagery might be that it is a return to introspection, a path that has already led to a dead end. In actuality, introspection is still alive and well (Boring, 1961; Kessel, 1972; Taylor, 1962). The answer to the question of accepting self-reports as data is suggested by Taylor's statement that in many cases there is no alternative. The prominent philosopher of science, Carnap (1956), supports Taylor: "A person's awareness of his own state of imagining, feeling, etc., must be recognized as a kind of observation, and, therefore, as a legitimate source of knowledge. Introspectional report is, by the very fact of being a report, public, and as such, a proper subject for psychological inquiry ..." (pp. 70-71). This attitude toward self-report was an important factor in the philosophy of this study.

There appears to be much being made of imagery in the field of psychology in recent years. It has been called an important and pervasive human experience, the existence of which cannot be questioned (Pylyshyn, 1973) and a distinct individual difference variable (DiVesta, Ingersol, & Sunshine, 1971; Simpson, Vaught, & Ham, 1971; Pylyshyn, 1973). In addition, Gordon (1972) and Singer (1966) proclaim that imagery is closely related to creativity with heavy input into art, literature, and music.

The foremost psychological area utilizing mental imagery is that of counseling/psychotherapy. Bugelski (1971) attributes the initial employment of mental imagery in a therapeutic situation to Freud and the psychoanalysts. It has been argued that just about any counselor/therapist uses imagery, either knowingly or unknowingly (Gordon, 1972; Horowitz, 1970). Horowitz (1970), a well known clinician and research scientist who is perhaps the most verbal proponent of imagery in therapy, writes that in the
therapeutic situation ... "the formation and communication of images can (1) yield information, (2) establish empathic understanding, (3) release and work through emotions, and (4) transform mood or attitude" (p. 282). Some believe that imagery will give additional insight into psychopathology (Costello, 1957; Richardson, 1972). It is also believed that during counseling/therapy, a client's image system is subject to modification (Gordon, 1972). In any literature review, it is readily evident that therapeutic applications of imagery are abundant (Adler, 1967; Assagioli, 1965; Beck, 1970; Biddle, 1969; Cautela, 1966, 1975; Cautela & Wisocki, 1971; Ferenczi, 1950; Gerard, 1963; Hammer, 1967; Holt, 1972; Horowitz, 1970; Jung, 1959; Kubie, 1943; Lazarus, 1971; Lazarus & Abramovitz, 1962; Leuner, 1969; Perls, 1970; Sacerdote, 1967, 1968; Sheehan, 1972a; Singer, 1974; Stampfl & Levis, 1967; Wolpe, 1958; Wolpe & Lazarus, 1966).

A related and relatively uninvestigated application of mental imagery is "mental practice" (Engstrom, 1964; Perry, 1939; Richardson, 1967a, 1967b, 1972; Sackett, 1934; Sheehan, 1972b). As in many therapy/counseling applications, target behaviors are rehearsed in imagery with the goal of increasing behavioral skill and effectiveness.

What is Mental Imagery?

What is imagery? What is an image? The answers to these questions are not yet clear. Imagery has been defined as conditioned sensations (Bugelski, 1971; Leuba, 1940; Mowrer, 1960; Paivio, 1969), as sensory experiences without simultaneously perceived stimulus objects (Gordon, 1972; Horowitz, 1970, 1972; Richardson, 1969; Zikmund, 1972), as a specific form of thinking (Horowitz, 1970), as an active constructive process involving
the revitalization of previously stored information (Bugelski, 1971; Holt, 1972; Neisser, 1972; Paivio, 1971a), and as a skill (Sarbin, 1972). Paivio (1971a, 1972; Paivio, Yuille, & Madigan, 1968) defines images in terms of the image-arousing value (concreteness) of the stimuli that elicit the imagery.

In the writer's judgment, the following are the best definitions that the imagery literature has to offer. Unfortunately, they also illustrate the confusion and limited knowledge in the area.

Richardson (1969) states:

Mental imagery refers to (1) all those quasi-sensory or quasi-perceptual experiences of which (2) we are self-consciously aware, and which (3) exist for us in the absence of those stimulus conditions that are known to produce their genuine sensory or perceptual counterparts, and which (4) may be expected to have different consequences from their sensory or perceptual counterparts (p. 2).

Bugelski (1971) states:

... how do you define an image? Does an image engender imagery and attendant emotional reactions? Can you have an image of an image? The word image does not refer to a concrete object; in fact, it does not refer to any object at all, and if we believe that for anything at all to be it must be in some form or structure, we have to admit that we know nothing about any form or structure that an image might possess or reside in (p. 51).

The responses involved in imagery are inferred, hypothetical, implicit, and internal, not observable by normal visual inspection of the responder. They are reported by the responder as localized in the head; they are not projected into the external world and are not identified as existing externally, as are hallucinations (p. 53).

Hebb's definition (1968) seems naturally to follow Bugelski's:

... with regard to a report of imagery ... one is not describing the image but the apparent object. This becomes clear if one observes the apparent locus of what one is describing. One does not perceive one's perception, nor describe them; one describes the object that is perceived, from which one may draw inferences about the nature of the perceptual process. In the case of imag-
ery, one knows that the apparent object does not exist, and so it is natural to think that it must be the image that one perceives and describes, but this is unwarranted. The mechanism of imagery is an aberrant mechanism of exteroception, not a form of looking inward to observe the operations of the mind. So understood, the description of an imaged object has a legitimate place in the data of objective psychology (p. 467).

It is certainly obvious that there are definitional problems in the psychological study of mental images and that there is yet a great deal to learn. There does, however, seem to be two directions that the imagery researcher can take: (1) he can endeavor to determine precisely what an image is or (2) he can assume that images exist and proceed to learn their function and potential utility. The writer has chosen the latter path.

An image is defined in this study as any sensory experience in the absence of a real stimulus impinging on the sensor. Lending credence to this definition, Neisser (1967) and Neisser and Kerr (1973) have stated that imaging involves many of the processes of perceiving without the assistance of incoming data. Consequently, Neisser and Kerr suggest this as the first criterion for deciding whether or not a report of introspection is dealing with imagery.

In conclusion, though one studies mental imagery, this is not reason for him to accept the naive mentalism to which most contemporary psychologists object. The best defense against this naive mentalism is an adequate understanding of imagery and its relationship to overt behavior (Day, 1969; McGlynn, Hofius, & Watulak, 1974). As stated by a prominent philosopher of science, "The reintroduction of introspection, the new concern with the phenomenal field, the clinical attention to subjective experience, the studies in social perception, etc., seem to me to indicate not indeed a
regression to an obsolete psychology, but an advance along the spiral ... of the evolution of the scientific outlook" (Feigl, 1959, p. 123).
Chapter II.

Literature Review

Historical Background

The original thinking and study of imagery began with the Greek philosophers, Aristotle in particular (Horowitz, 1972; McMahon, 1973). Aristotle theorized that mental images were sources of motivation that energized and gave direction to man's behavior. In his historical review, McMahon notes that many contemporary psychologists have again accepted this notion which has endured from the Greek philosophers to the beginning of the twentieth century. In 1883, Sir Francis Galton conducted the first and still referenced study of mental imagery which concerned individual differences in vividness of imagery. Imagery remained an important part of early psychology until the beginning of the 1900's and the advent of behaviorism (Boring, 1942; Hebb, 1960; Horowitz, 1972; Kessel, 1972; Leibovitz, London, Cooper, & Hart, 1972; McKellar, 1973; McMahon, 1973).

(It is noted at this point that most references to behaviorism in this chapter are directed mainly toward the early behaviorists who did not allow introspection and self-report in their view of psychology. It is acknowledged that many contemporary behaviorists have since changed radically. This literature review accurately reflects the negative reaction in the imagery literature toward early behaviorism. It also shows, however, that contemporary behaviorists and behavior therapists are now in the process of making significant contributions to the study of mental images on theoretical, experimental, and clinical levels. In fact, many of today's behavior-
ally oriented psychologists have been responsible for the upsurge of interest in, and the study of, mental imagery.)

Early behaviorism forced psychology to purge itself of attention, states of consciousness, imagery, and all other mentalistic concepts. It was J. B. Watson who launched the most enthusiastic attack upon imagery. He (Watson, 1930) flatly stated that there is absolutely no evidence in behaviorism of any mental existences or processes. To him images were merely "ghosts of sensations" in which he did not believe (McMahon, 1973). He replaced images with stimuli and imagination with sensory stimulation. The ultimate blow delivered by behaviorists was to invert the classical role of the image in motivation by placing the proverbial cart before the horse. Images were given the functionless role of byproducts of motives, needs, or drives (McMahon, 1973). The following quotation is a good example of the contemporary view of Watson and the early behaviorists: "Things which did not fit in with the narrow methodology which Watson sought to impose on psychology he did not wish others to study. There are few more dangerous activities in science than telling other people what they ought not to do. In the words of an important contemporary investigator of the field there is no better answer to those who would taboo a topic than a set of stout reliability coefficients" (McKellar, 1973, p. 13). It was hoped that the results of this study would produce those coefficients.

Another reason that the behaviorists avoided imagery was due to the inadequate research methodology of the time which produced unreliable and contradictory results (McGlynn, Hofius, & Watulak, 1974; Sarbin & Juhasz, 1970). In this accusation, it is the writer's opinion that the behaviorists were correct. An added problem occurred in the cognitive psychology
of the early 1900's, where images were no longer considered to be the basic units of thought, and the effort to categorize people by favored-mode-of-imagery-type was a failure (Horowitz, 1972). Finally, as suggested above, imagery was avoided due to the belief that images could not influence overt behavior (McGlynn et al., 1974). Recent evidence suggests that those adhering to Watson's philosophy were incorrect. Paivio (1971a), Palermo (1970), and Reese (1970) are just a few research psychologists who show that imagery does influence overt behavior, while many clinician/researchers have demonstrated that overt behavior can be modified through the deliberate manipulation of images (e.g., Cautela, 1970, 1975; Stampfl & Levis, 1967; Wolpe, 1969).

In an unpublished doctoral dissertation, Cordner (1970) indicated that now that imagery is held in high regard three important shifts have occurred in the thinking about mental imagery. First, while images were once viewed as representational, they are now seen as symbolic. Second, images are seen as purposeful instead of being accidental. Finally, images are seen as creative instead of mere sensory imitations. All three trends of thought demand further research.

**Imagery in Counseling/Psychotherapy and Psychopathology**

Counseling/Psychotherapy

There has been a strong revival of imagery in the area of counseling/psychotherapy. The most enthusiastic contributions are evidenced in the heavy use of imagery by behavior therapists. Just a few of the therapeutic imagery techniques are systematic desensitization, implosive therapy, flooding, focusing, covert reinforcement, covert extinction, covert sensi-
tization, induced fantasies, and symbolic imagery (Barrett, 1970; Beck, 1970; Cautela, 1966, 1967, 1970, 1971, 1975; Cordner, 1970; Evans & Kamemoto, 1973; Gendlin, 1969; McCullough & Powell, 1972; Rachman, 1966; Stampfl & Levis, 1967; Williams, 1972; Wolpe, 1958). All techniques employing mental imagery depend heavily on the client's ability to produce vivid images, and if the patient cannot produce the target images, there is little or no chance of success (Beere, 1972; Burley, 1973; Gaupp, 1973; McKellar, 1973; Rehm, Mattei, Potts, & Skolnick, 1974; Weiner, Weber, & Concepcion, 1973). There have been numerous research reports demonstrating that imaging ability is both necessary and a useful force in these techniques (for example, Cordner, 1970; Himle, 1971; Perloff, 1970; Waters & McDonald, 1973; Williams, 1972). Cordner (1970) has an excellent review of the analytic and nonanalytic methods of imagery in psychotherapy.

Cordner (1970) also states that imagery is very helpful in cases where the underlying conflict is either unavailable or irrational. It helps the client deal with problems in a nonverbal way. This is clearly demonstrated in Wolpe's systematic desensitization where the image is treated as an external stimulus (Beck, 1970). When the person is trained to deal with and control these images, there is often a reduction in anxiety. In truth, there is often a great deal of emotion attached to mental images (i.e., they are often repetitions of traumatic experiences) which makes them prime targets in counseling/psychotherapy (Beck, 1970; Gaupp, 1973; Horowitz, 1972; McMahon, 1973).

Horowitz (1968) lists four situations where "visual thought" is likely to arise in counseling/therapy:
(1) When there is resistance to forming a lexical thought product there may be a shift to nonlexical thought.
(2) Visual images may arise when the patient does not have immediately available to him the verbal facility to represent some experienced set of feelings or ideas.
(3) Memories which are preverbal, emotionally arousing, highly meaningful, and/or partially screened from consciousness may first enter awareness as imagery and lose this sensory quality only when they are translated into lexical terms and the associated affect is worked through.
(4) Imagery increases with regression in thinking, drowsiness, and altered states of consciousness (p. 58).

Research into proper assessment of the imaging ability of counseling/therapy clients is practically nonexistent. That which does exist is not very sophisticated. For example, McCullough and Powell (1972) have their clients rate target images on a scale of zero to ten, using the technique to screen out clients needing imagery practice. It was anticipated that the results of this study would produce a psychometrically sound assessment device for evaluation of the client's imaging ability. With this information, the counselor/therapist would be able to tailor his imaging techniques to the individual client.

**Psychodiagnosis and Psychopathology**

Mental images are also valuable as diagnostic aids, since feelings and ideas often are not available to verbal expression. In many instances, they may only emerge as images, which then scrutinized may clarify many problems (Beck, 1970; Horowitz, 1968, 1972). Chapman (1967) showed that many behavioral manifestations of psychopathology are based on the client's fantasies, while Beck (1970) demonstrated that certain imagery themes are associated with nosological categories and psychopathological states. Kawliche (1969) even states that in many cases imagery can serve the same functions as dreaming and as such is potentially useful in psychodiagnos-
tics. The powerful effects that imagery has upon clients has been experimentally demonstrated by the use of imagery to modify and control such responses as penile erection, heart rate, GSR, EEG, and autonomic nervous system activation in general (Acheson, 1972; Cahill, 1972; Evans, 1972; Nelson, 1973; Stern & Kaplan, 1967; Waters & McDonald, 1973).

Beck (1970) points out that there is a close bond between a client's imagery and his affect. Horowitz (1968), in agreement with Beck, reports that imagery is reported in all diagnostic categories. If observed, imagery will give many clues to cognitive dynamics and shed light on the client's idiosyncratic perception of reality (a profound effect on subjective and overt experience and behavior). Beck notes that in anxiety reactions, depressions, and phobias, the fluctuation of credibility and vividness of imagery is easily observed.

There has been much written about the role of imagery in the psychoses. In 1917 Freud noted that the essence of reality testing (a diagnostic factor) was the ability to distinguish images from actual perceptions (Silverman, Pettit, Goldweber, & Spiro, 1971). Lending research support to Freud, Mintz and Alpert (1972) have demonstrated that schizophrenics experience vivid imagery and that their reality testing is impaired. They are not able to distinguish internal from external stimuli.

In addition to establishing that auditory images are the primary mode of hallucination and that both schizophrenics and normals experience the same types and frequency of mental images, the majority of research in this area strongly support Mintz and Alpert's findings (Beck, 1970; Malitz et al., 1962; Mintz, 1971; Roman & Landis, 1968; Shapiro, 1972; Silverman et al., 1971; Spanos & Barber, 1968). The closest phenomenon to the psy-
chotic experience of imagery is "runaway imagery," a bad experience that is occasionally encountered in systematic desensitization and implosive therapy (Barrett, 1969, 1970).

**General Experimental Imagery Research**

Though the number of questions about imagery is large, there has been a great deal of general imagery research outside of psychotherapy. For example, images have been found to differ in content (Horowitz, 1970; Neisser, 1972; Sheehan, 1972a) and sensory mode (Betts, 1909; Paivio, 1971a; Sheehan, 1972a). They may be examined in terms of context, vividness, controllability, and sensitivity to the influence of perception (Betts, 1909; Gordon, 1949, 1950; Horowitz, 1970; Richardson, 1969; Segal, 1971; Sheehan, 1966a, 1966b, 1967a, 1972b). Bugelski (1971) also writes that images are dynamic, fleeting, and not subject to influence and direction by the imager. (The writer disagrees with Bugelski on several points.)

It has been suggested that mental images can be prevented or interfered with by gross muscle movement (or any physical activity for that matter) and a direct effort to produce them (Bugelski, 1971). This implies that the lack of movement, relaxation, and reduced extraneous sensory stimulation will facilitate imaging.

**Imagery As An Experimental Variable**

Other lines of evidence suggest that imaging behavior may be brought under experimental control. For example, McCullough and Powell (1972) and Rehm et al. (1974) say that practice will increase vividness. Image vividness and latency may also be reliably manipulated by varying the complex-
ity of the image (McGlynn & Gordon, 1973; McGlynn et al., 1974; Pear & Cohen, 1971). Vividness may also be manipulated by varying image aversiveness (Lang et al., 1970), while latency and vividness may be influenced by manipulating image concreteness (Paivio, 1968, 1971b). Brooks (1967) has found that visual imaging may be suppressed through reading. Lending support to Brooks, Fusella (1973) has demonstrated that vivid imagers may confuse images and external stimuli (a finding which he considered as support for imagery being conceptualized as a quasi-perceptual process).

Bower (1970), Morris (1971), Morris and Gale (1974), and Paivio (1971a) established that instructions to image improved performance on recognition memory tasks. In fact, images have been found to be an important factor in memorization (Paivio, 1969, 1971a; Sheehan, 1972b). It is easier to learn concrete words (nouns depicting readily visualizable objects, i.e., car, door) than those that are more abstract (Paivio, 1969, 1971a, 1971b). There have been numerous experiments by Paivio as well as others that have confirmed that imagery improves learning and memory (Aiken, 1972; Bower, 1970, 1972; Bugelski, 1974; Bugelski, Kidd, & Segman, 1968; Butter & Palermo, 1970; Ernest & Paivio, 1969; Luria, 1968; Morris & Gale, 1974; Neisser & Kerr, 1973; Paivio, 1971a, 1971b; Paivio & Madigan, 1968; Phillips, 1971; Rehm, 1973; Ross & Lawrence, 1968; Yates, 1966). It seems that vivid clear imagery is more easily aroused by concrete than by abstract nouns (Sheehan, 1972b). Kessel (1972) feels that Paivio's establishment of the functional relationship between imagery and learning and memory contributed significantly to the eradication of "pseudo-objective" taboos against imagery research.
Paivio (1969, 1971a) suggested that there are two operations in the memory process: (1) a verbal process based on words and specialized for sequential processing and (2) an image process that is specific to spatial representations and based on imagery. This view was first proposed by Griffiths (1927) who said that visual imagery dominated concrete imagery for most individuals and that they were concrete thinkers. He also said that those who used verbal imagery subordinated visual imagery to inner speech and were verbal (possibly more abstract) thinkers.

Other general psychological research studies have demonstrated that mental images have significant effects on electrodermal responses (Beck, 1970; Horowitz, 1972; Stern & Kaplan, 1967), occipital EEG (Gale et al., 1972), and hypnotic behavior (Graham, 1970; Lehman, 1973). Also, subjects using imagery are better able to combine mentally shapes than those who do not use imagery (Ranken, 1963). Images have been found to improve dart throwing (Vandell, Davis, & Clugston, 1943) as well as other athletic activities (Jones, 1965; Start, 1960). It has also been claimed that imagery is involved in poor spelling (Pierro, 1967) and personality (Luce, 1971). Finally, Leibovitz et al. (1972) suggest that the dominant imagery modality should be considered in vocational counseling since Griffiths (1924) has pointed out that a criterion for success as a cartoonist, illustrator, architect, designer, or many types of engineers is visual imaging ability.

As a final example of imagery research, it has been found, on occasion, that imagery may be stimulated by the occurrence of after-images, while images themselves may cause after-images (Erickson, 1938; Onizawa & Kato, 1971). In other words, a whole series of visual images may grow from
the after-image of a flash-bulb, while the visual image of a flash-bulb may produce an after-image similar to that of a real flash.

Theories of Imagery

There are several theories of imagery and a multitude of mostly unconfirmed theoretical statements. First a representative sample will be listed:

1. Imagery is a primitive mode of thought that is later replaced with verbal thinking (Horowitz, 1967; Kessel, 1972).

2. Indirect evidence for mental images is the fact that a motivated man or animal knows precisely what he wants despite the fact that the object is hidden from view (McMahon, 1973).

3. Imagery and perceptual processes are so similar that they occupy the same sensory systems in any one modality, and they may even interfere with one another (Atwood, 1971; Brooks, 1967; McMahon, 1973; Neisser & Kerr, 1973; Segal & Fusella, 1970).

4. Imagery is a luxury; when thought and concepts are too abstract and beyond our vocabulary, they are concretized in mental images; images allow information to be processed long after perceived events (Bartlett, 1927; Horowitz, 1972; Kessel, 1972; Neisser, 1967; Pylyshyn, 1973).

5. The following is cited by Pylyshyn (1973):

Some writers have suggested that images are related to conditioned sensations (Staats, 1968), to 'indirect reactivations of former sensory or perceptual activity' (Bugelski, 1970, p. 1002), or that they are 'a faint subjective representation of a sensation or perception without an adequate sensory input' (Holt, 1964, p. 255), or 'the occurrence of perceptual processes in the absence of stimulation which normally gives rise to perception' (Hebb, 1966, p. 41), or imagery is defined as 'the ability of a subject to generate or synthesize a sensory-like datum in the
absence of physical stimulation' (Weber & Bach, 1969, p. 199) (p. 8).

6. The reason why some people use more images in their thinking than those who use more language symbols is that each group has had a different reinforcement history for using either strategy. Permissive child-training may result in continued use of imagery (DiVesta et al., 1971; Hollenberg, 1970).

Probably the most useful theory of mental imagery was proposed by Taylor (1973). Taylor began the presentation of his theory by noting the inconsistency of contemporary behaviorism: "There is a serious contradiction at the heart of modern behaviorism. On the one hand leading behaviorists continue to assume there is no need for any reference to consciousness within their discipline; and on the other hand behavior therapists have no hesitation in using the conscious phenomenon of visual imagery as a therapeutic tool" (p. 1). Taylor (1962, 1973) extended the behavioral theory of perception and derived a theory of imagery consistent with the basic principles of behavior.

It is felt that an adequate communication of Taylor's theory is best done with Taylor's own words.

The essence of the theory is that (a) The acquisition of any learned response entails the construction in the brain of a network of neural links (hereafter called an engram) that has to be aroused to activity before the response can occur; (b) An engram can be activated even when the final common path to the motor apparatus is not available; (c) Receptor surfaces such as the retina, the basilar membrane and the skin can, in conjunction with the proprioceptors, activate a large number of engrams simultaneously; (d) This has the effect that the organism is in a state of multiple simultaneous readiness for all the relevant responses; (e) The similarity of this state of multiple readiness entails the emergence of a new property, viz, consciousness and (f) The content of consciousness is determined by the behaviors mediated by the active engrams (pp. 1-2).
... if the efferent component that is common to all of the elements of an equivalence class can be aroused to activity by some stimulus other than the efferent components of one of the engrams, some kind of perceptual experience should result, and it will bear some resemblance to the perception aroused by the actual presence of the object (p. 2).

The question ... whether there are any other stimuli than the standard ones, that are capable of activating the terminal components of the engrams that mediate the visual perception of an object. The main requirement of such a stimulus is that it should, within the experience of the subject, be uniquely associated with the object. ... Initially these stimuli operate on a different receptor system from those that generate visual perception; but because the two classes of stimuli are frequently in operation concurrently, there is no reason why one should not become conditioned to the responses primarily evoked by the other (p. 3).

When conditioning is studied in the laboratory, where the order of stimuli can be carefully controlled, it is found that normally the CS must precede the UCS. When the order is reversed, the CR develops weakly or not at all. In everyday life, on the other hand, the ordering of stimuli varies in a random fashion, and it happens quite frequently that a person's name is pronounced or his voice is heard before he is seen. In that case it is quite feasible for the name or voice to become conditioned to the terminal components to the subset of engrams that mediate visual perception of the person's face. Then since the essence of conditioning is that the conditioned stimulus can evoke the response in the absence of the UCS, one can deduce that a person's name or the sound of his voice can arouse in the subject a conscious experience that is closely akin to the visual perception of the person. In short, he has a visual image of an absent person (pp. 3-4).

Taylor offers four theoretical deductions: (1) The entire range of types of imagery may be found in any random sample of persons, (2) Eidetic imagery incidence is zero in early childhood, increases dramatically, and then drops to a consistent low level in adults, (3) Training will increase vividness and controllability of imagery, (4) Dream images are the result of an activation of the terminal components of those engrams which mediate perception; people with no waking images can have dreams.
Taylor (1973) suggests that the production of mental images is often reinforced by the mere pleasure of experiencing the images and the delight in reviewing scenes that are long past. Similarly, Cautela (1970), a clinician/researcher, has learned about and made use of mental images as reinforcers.

A second theorist, King (1973), has proposed that in conditioning the CR is a result of a CS-produced image of the UCS. Therefore, an image of the UCS is produced by the CS which then results in the CR. King feels that image theory is applicable to classical conditioning because:

(1) similar responses are produced by both real and imagined stimuli and

(2) there is a close resemblance between CR and UCR.

This hypothesis makes sense, e.g., for salivary conditioning, the CS produces an image of the food and salivation therefore occurs just as salivation occurs when we imagine food (p. 403) ... since vivid images resemble perceptions more than faint images (by definition), a vivid image of the stimulus should produce responses that are more similar to the ones elicited by the real stimulus than are the ones produced by a faint image of the same stimulus, i.e., the responses produced by vivid images should be stronger than those produced by faint ones (King, 1973, p. 408).

Didlo (1970) hypothesized that since eidetic imagery is a human response, operant shaping could be applied to eidetic imagery. His results confirmed the hypothesis. Twenty-five percent of his subjects developed eidetic imagery demonstrating that it is possible to shape eidetic imagery. These results seem to interfere with Snyder's proposal (1972) that images are the result of a person's internally activating a stored stimulus code, such as thinking of the name of an object. Shapiro (1972) suggests that reduction of contact with the real world will alter visual imagery by allowing more primitive image structures to emerge (i.e., through free association and sensory deprivation). Shapiro hypothesizes that there are
three factors that determine how a visual image will appear and be experienced: (1) How well organized the image is (memory to hypnogogic); (2) Whether the image is accepted as real or not (sleep or waking dreams); and (3) How the individual uses regressive thinking, his perceptual style, and his tolerance for fantasy.

Travers (1970, as cited in Lin, 1972) hypothesized that eidetic imagery could be the consequence of a retarded erasure mechanism. Because this mechanism is retarded, images from preceding stimuli would persist for a long time thus over-lapping subsequent perceptions. Lin (1972) tested this hypothesis and confirmed that eidetic children do in fact have visual images that persist.

The last general theory was presented by Juhasz (1972) and Sarbin and Juhasz (1970). This is the role-taking approach, the model of man as actor, an active symbol-making person. They feel the imagery is best analyzed in terms of the ability to assume another role. According to Sarbin and Juhasz (1970):

... persons characterized as vivid imagers, lively fanciers, etc., are adept at imitation (copying with the model present) and at role-taking (imitation with the model absent) (p. 72). The findings are consonant with a view of imagining not as the skill in the inspection of replicas of percepts stored in the mind, nor in the reflection of a past history of haphazard pairing of experience, but rather as the exercise of a sophisticated aspect of man's ability to act as if (p. 75).

After reviewing the above, it is the writer's opinion that the theories of Taylor and King deserve closer scrutiny and demand further research effort.
Imaging and the Sensory Modalities

Theoretically, it is possible for a person to image in any sensory modality. At one time or another, psychologists have written about or studied each of the visual, auditory, olfactory, gustatory, tactile, kinaesthetic, and organic-somesthetic imagery modalities. Lindauer (1969) states that the sensory characteristic of mental images has been generally overlooked. What often occurs in the literature is an implicit and incorrect assumption that all of the senses are unitary, an assumption that leads to unexpected, contradictory, and inconsistent findings (Lindauer, 1969; Simpson et al., 1971). The assumption that people have a general ability, though probably incorrect, is still a matter of issue.

A recurring notion in the literature is that visual images are most available to study and that vision is the dominant imagery modality (Beck, 1970; Holt, 1964; Horowitz, 1972; Kessel, 1972; Leibovitz et al., 1972). Research has shown, however, that tactile imagery is the most reliably measured image modality (Evans & Kamemoto, 1973; Hertz, 1972; Richardson, 1969).

Leibovitz et al. (1972) claim to have determined that in the general population there is a frequency hierarchy of image modalities, however, the order of ranking on this hierarchy is open to question. Their rank order (from most frequent to least) was visual, auditory, kinaesthetic, tactile, and olfactory-gustatory. The Leibovitz et al. (1972) hierarchy is similar to that of Schlargel (1953), which was (most to least frequent) visual, auditory, kinaesthetic, tactile-temperature, olfactory-gustatory, and unknown. Lindauer (1969) found high imagery values for tactile and gustatory words, intermediate values for visual and olfactory words, while audi-
story words were low in imagery. Lindauer accurately comments that unfortunately the majority of imagery research has dealt with the visual modality, less with auditory imagery, and least with taste, touch, and smell.

Vividness and Controllability

The first major factor (both conceptually and statistically) in imagery is vividness (Richardson, 1972; Sheehan, 1972a). "No image" would be the lowest order of vividness, while an image that is crystal clear, photographic, and appears to be real would be maximum vividness. Marks (1972) writes that people who are capable of producing vivid imagery possess an information source unavailable to those with vague, dim images. He gives no concrete suggestions as to the source of this information.

The importance of vividness has been cited throughout the literature. Counselor/therapists usually assume that vivid images are produced, and a few even try to verify the vividness. Factor analytic studies have reported high factor loadings for imagery vividness (Evans & Kamemoto, 1973; Richardson, 1969), while others (e.g., McLemore, 1971) have found vividness to be a unitary attribute across sensory modalities that is distinguishable from controllability, unaffected by acquiescence, and only slightly biased by social desirability. A problem that is encountered in the study of vividness is that it cannot be directly validated by a criterion (Betts, 1909; Evans & Kamemoto, 1973).

The second major factor in imagery is controllability. The ability to control one's own thoughts is a central problem in image formation (Horowitz, 1970; Richardson, 1969). Costello (1956, 1957) and Gordon (1950) found a relationship between control of mental images and control of
actual percepts. People have also been classified by their control of mental images in relation to various personality characteristics (Gordon, 1949, 1950; Jaensch, 1930; Richardson, 1969; Sheehan, 1972a). For example, Gordon (1949) classified subjects by autonomous or controlled imagery. McKellar (1973) writes that research has all but neglected the study of image controllability, and the writer has found this to be true.

Though the concept of imagery is vague and difficult to measure (Sheehan, 1972a), Richardson (1972) writes that studies of imagery must contain both the factors of vividness and controllability. It is already known from both research and clinical experience that these factors are essential for success in such therapeutic imaging techniques as systematic desensitization, covert sensitization, and numerous other behavior therapy approaches (Ashem & Donner, 1968; Bandura, 1969; Cautela, 1966, 1971; Horowitz, 1970; Lazarus, 1964; Richardson, 1972; Sheehan, 1972a). Few studies have taken into account both factors simultaneously (i.e., Evans & Kamemoto, 1973; Jones, 1972; Leibovitz et al., 1972; Snyder, 1972).

**Individual Differences in Imaging**

Most people who have studied mental imagery and who have had worked clinically with other people's imagery would agree that there are obvious individual differences in imaging ability and behavior. This has been demonstrated repeatedly in the literature, and there are many articles calling for more individual differences research (Bartlett, 1921; DiVesta et al., 1971; Gale et al., 1972; Horowitz, 1972; Kessel, 1972; Leibovitz et al., 1972; Morris & Gale, 1974; Pylyshyn, 1973; Spodak, 1973).
As early as 1880, Galton detected wide individual differences in vividness, while Charcot developed the theory that there were distinct types of people, i.e., visual types, auditory types, kinaesthetic types, etc. (Leibovitz, 1968; Leibovitz et al., 1972). The majority of research, however, has not found that imaging is a general dimensional trait across modalities (Horowitz, 1972; Leibovitz et al., 1972; Sheehan, 1967; Simpson et al., 1971). There is, however, evidence that there is such a thing as an ability to produce mental images (Ernest & Paivio, 1971; Gale et al., 1972).

Holt (1964) has noted five dimensions, along which he has observed that images (not people) vary (Kessel, 1972):

1. Degree of dependence on external stimuli.
2. Flexibility and degree of conscious control.
3. Amount, vividness, and duration.
4. Degree to which image is tied to affect.
5. Sensory modality.

It has been noted by several writers that about 95% of the general population experiences visual imagery, and that within this modality the image quality varies over a wide range (Beck, 1970; Betts, 1909; Horowitz, 1972; McKellar, 1972, 1973; Singer, 1966). It has been suggested that it might be better to speak of low-imagers rather than nonimagers (McKellar, 1973) due to the fact that it is often harder to find nonimagers than imagers. In support of this, Davis, McLemore, and London (1970) found some personality differences between good and poor imagers. Future research may show that there really is no such thing as a person who does not produce mental images because it has been observed that many people do not attend
to, or they forget their imagery experiences (many vivid imagers have a hard time believing those who claim to be imageless) (Beck, 1970; McKellar, 1973; Sheehan & Neisser, 1969; Simpson et al., 1971; Taylor, 1973). When clients have been introduced to imaging during counseling/therapy, it has been noted that they sometimes experience spontaneous images between sessions (Beck, 1970). This suggests that therapy may sensitize people to their already occurring imagery experiences.

Occasionally subjects report that their images were exaggerated forms of visual or auditory stimuli (Waters & McDonald, 1973), and it has also been demonstrated that vividness and formation latency are correlated (Rehm, 1973; Rehm et al., 1974). Psychologists who research both imagery and hypnosis have determined that vividness and susceptibility are positively correlated (Perry, 1973; Sutcliffe, 1961; Sutcliffe, Perry & Sheehan, 1970).

It has been reported that imaging ability is useful and often important in various occupations. Horowitz (1972) writes that, "Skill at conceptual manipulation by formation of visual images is useful to architects, painters, surgeons, and psychoanalysts during dream interpretation. Skill at auditory image formation is useful in poetry and music, kinaesthetic imagery in dance, gustatory imagery in cooking" (p. 799). The writer has been told that kinaesthetic imagery is useful in the study of mime. Biologists and experimental physicists claim to possess high visual imagery, while imagery processes are rejected for verbal processes by theoretical physicists, anthropologists, and psychologists (Leibovitz et al., 1972; Roe, 1951). Betts found psychologists (those of the time, 1909) to be defi-
cient in imagery, a phenomenon he explained by their adherence to abstract thinking (Leibovitz et al., 1972).

Juhasz (1972) and Leonard and Lindauer (1973) found that people who are artists (or at least have an aesthetic bent) are generally the better and more frequent imagers. Both studies left the question of sex differences still moot, each producing opposite results. While there have been significant findings in studies of imaging and personality, there are no undisputable data (which is congruent with the findings of sex differences). Extroverts are supposedly the better imagers (Gale et al., 1972; Morris & Gale, 1974), and there appear to be some significant differences between various scales in the 16PF and CPI (Broadway, 1972). Psychologists who research both imagery and the electrical activity of the brain have suggested that there is a positive relationship between individual differences in EEG and the ability to produce mental images (Gale et al., 1972; Golla et al., 1943; Leibovitz, 1968; Morris & Gale, 1974).

Spodak (1973) found clear individual differences in imaging among children.

**Eidetic Imagery**

Probably the most dramatic form of mental imagery is "eidetic imagery." Eidetic images appear to be externally located, vivid, long-lasting, positive in color, and do not require a fixed gaze (Gummerman et al., 1972; Kessel, 1972; Leask et al., 1969; Richardson, 1969). The following criteria were established by Haber and Haber (1964) for verifying a person's ability to produce eidetic images, "(1) An image must be reported, (2) it must be colored positively, (3) it must be localized on the easel (rather
than in the head), (4) the subject must use the present tense to describe the image, and (5) eye movements made during the report must correspond to the part of the picture described. Two secondary criteria are that the image last longer than 40 seconds and that the report be reasonably accurate" (Gummerman et al., 1972).

In the general population, the frequency of children's possessing eidetic ability varies with the study (i.e., 8 to 50%) (Haber, 1969; Gummerman et al., 1972; Siipola and Hayden, 1965). Pierro (1967) found that good spellers are good eidetic imagers, but there were no sex differences. Doob (1966) found that primitive peoples have more frequent and more persistent eidetic imagery than more culturally sophisticated groups. Sheehan (1968) hypothesizes that color responses to the TAT may ultimately be accounted for by eidetic imagery. This writer wonders if some color responses to the Rorschach may also be partially explained by the ability to form eidetic images.

Measuring Mental Images

Accurate assessment of mental imagery is probably the most obvious block to the understanding of imaging behavior. At present, there is no satisfactory instrument for the assessment of imaging ability. "It is worthy of note that one of the most widely used scales measuring vividness of imagery is but a shortened form of the questionnaire devised by Betts in 1909" (Evans & Kamemoto, 1973). The facts are similar for controllability.

In those studies where an attempt was made to assess imaging ability, the data of each were most often based on a measurement instrument devised by the experimenter. The literature abounds with independently derived and

Kessel (1972) suggests that one factor in the increasing trend of imagery research is that the Zeitgeist is cognitive-experimental. Rehm (1973) notes that systematic assessment of individual differences in imaging has yet received only limited study. Most previous research has dealt either with image quantity or quality. This study has dealt with both. Rehm et al. (1974) write that the majority of imagery research has examined it as an independent variable, and they suggest that vividness should be looked at as a dependent variable.

Kessel (1972, p. 156) cites the following:

... in devising a "new" methodology of introspection or self-observation, we will have to confront questions such as the reliability of phenomenal language, the nature of relation between experience and report (Natsoulas, 1967) the formation of dependent and independent variable categories for experiential data, and the necessary qualifications and abilities of subjects. But there is no intrinsic reason why such problems cannot be dealt with. In fact, the greatest contribution of recent research on imagery lies in its demonstration that systematic study is possible and that these difficulties can be overcome.... The study of imagery and of other experiential events does not differ, in basic principle, from the study of other psychological phenomena: "There is no reason to think that experiential evidence cannot be treated methodologically in the same manner as any other evidence. Consequently, experimental designs, statistical inference, control group studies, rigid specification of stimulus conditions, etc., ought to be utilized in the interest of scientific objectivity (Meissner, 1966, p. 526).

Rehm (1973) states that for both research and clinical purposes, an independent and objective imagery assessment device is most desirable.
Also calling for a new assessment device is Evans and Kamemoto (1973), who note that the visual and organic sections of Sheehan's short form need revision.

Though we can assume that mental images exist and acknowledge that imagery is experienced by nearly everyone, the serious image researcher must face one inescapable fact. There is no way to measure directly a person's imagery. In fact, the major obstacle to imagery research is measurement (Richardson, 1969). There is no way to directly communicate an image to a second person (Gordon, 1972); two people cannot directly compare their imagery (Marks, 1972); and people tend to ignore and/or be unaware of their imagery experiences (Gordon, 1972; Horowitz, 1970). Imagery is a very private experience, the contents of which can be described only by an introspective report (Bugelski, 1971; Horowitz, 1970). Bugelski (1971) writes that we still know relatively little about what happens within a person who reports that he is experiencing mental imagery.

Before serious imagery research can be attempted, a reliable measurement instrument must be designed and valid uses determined. It is felt that there are several important reasons for the development of an imagery test: (1) Imagery is heavily utilized in therapy/counseling; (2) At present there is no adequate measure of imagery; (3) If the techniques for the development and modification of imaging ability are to be designed, a proper measure of their efficacy is required; (4) Researchers and therapists need measures to categorize subjects and clients on any imagery modality; (5) If imagery plays a significant role in everyone's life, it should be rigorously investigated. Initial test uses for the researcher might be as pre- and post-measures and for selecting suitable subjects for research.
The therapist, on the other hand, might utilize them to select therapeutic imaging procedures tailored to the individual client's ability to image.

Though the measurement problem is certainly formidable, it is not reason enough to exclude imagery from serious scientific investigation (Hannay, 1971; Lazarus, 1971). The fact that nearly everyone is able to report and describe some form of imagery experience suggests that there must be some internal stimulus to which people are responding (Bugelski, 1971).

In line with the internal stimulus notion, Tompkins (1962) believes that imagery (daydreams) is an important, nonpathological experience that is an ability requiring practice and privacy, which is potentially rewarding for each individual.

Though, at best, images can be studied through inference or self-report (Bugelski, 1971; Doob, 1972; Horowitz, 1970), the writer agrees with Singer (1966) that the search for better, or even direct, methods of measuring images is worth the effort. Hannay asserts, "Imaging occurs, there are mental images, and we see them" (1971, p. 175). It is also likely that people differ in their imagery experiences (Gordon, 1972) though similarities across persons probably do exist (Paivio, 1971a).

Hebb (1968) writes that a description or self-report of imagery need not be introspective though he does not actually elaborate this point. Regardless of whether it is introspective or not, people are able to describe images involving sight, smell, touch, sound, and movement (Horowitz, 1970; Richardson, 1969; Segal, 1971; Sheehan, 1972a; Singer, 1966). Horowitz (1970) writes:
A person can describe an image in many ways, including information about contents, vividness, clarity, color, shading, shapes, movement, foreground and background characteristics, and other spatial relationships. Furthermore, a person can often tell how the image entered his awareness, its duration, associated emotions, the relationship of the image to objects in the external world, efforts to change or dispel it, and the sequential or simultaneous arrangement of a series of images (p. 3).

At present, there are only a few tests designed to measure mental imagery (e.g., Betts, 1909; Gordon, 1949; Singer, 1966; Sheehan, 1967a). Aside from their limited sampling potential and possible unreliability (Richardson, 1969, 1972), the fact that each measures only one dimension of imagery (vividness or controllability) is also a handicap for the researcher and therapist as well. It would be more economical if a single test were devised to measure both factors simultaneously. A dual-function measure, sampling more modalities with more items, would be a major advance in the study of mental imagery.

The writer's goal was to construct an alternate-form measure (two parallel tests) that would permit simultaneous measurement of vividness and controllability on the same test items. It was to be an untimed, paper-and-pencil, self-report, computer-scored instrument.
Chapter III.

Method

Subjects

Subjects were 129 male and 221 female volunteers (N=350), ranging in age from 18 to 21 years, from undergraduate psychology courses at Iowa State University. They were asked to participate in a study of mental imagery. Subjects were offered classroom credit as incentive to volunteer.

Tests and Materials

Two paper-and-pencil, computer scored, parallel-form tests of self-reported mental imagery were written completely and independently by the author. Each test assessed imagery in seven sensory modalities, and each item measured both vividness and controllability. The procedure and results sections of this study present the psychometric data for these tests.

Four additional tests were administered for a brief validity test to a subgroup of subjects (54 males and 98 females). The first was the visual imagery subtest of Sheehan's (1967a) shortened version of the Betts QMI (Betts) (Betts, 1909). The Betts (a test only of vividness of imagery) exists in only one form and in various studies (e.g., Sheehan, 1967b) the whole test has been shown to have a test-retest reliability estimate from about .78 to .95. Items for the visual subtest were originally selected on the basis of a factor analysis of items. Five target items comprise the visual subtest.

The second test was the Gordon Test of Visual Imagery Control (Grdn) (Gordon, 1949), a test only of controllability of visual imagery. This has
been the only test of this type. The Grdn exists in only one form, and the split-half reliability estimate for this test is about .85. Twelve target images comprise this instrument.

The third instrument administered was the Survey of Object Visualization (SOV) (Miller, 1955). The SOV attempts to assess the ability for solving problems involving the recognition of an object's appearance in an altered shape or position. The test was designed as an aid for persons doing counseling or personnel work who need to be able to identify people with the ability to perceive spatial relationships. Reliabilities of .91 (split-half; N=266) and .92 (Kuder-Richardson; N=188) are reported for the SOV in the SOV manual. Validity studies have shown the SOV related (r=.44) to grades in dental school (Peterson, 1948). In a separate study, Layton (1953) has also shown the SOV predictive of success as a dental student (r=.49). The relationship between the SOV and success in a clothing construction course has also been demonstrated (r=.34) (Patson, 1952).

The final instrument was Test 5 - Space Visualization: Form A of the Employee Aptitude Survey (SV) (Ruch & Ruch, 1963). The test involves looking at the three-dimensional drawing of a stack of blocks and determining how many other blocks are touching certain labeled blocks. The SV is supposed to assess the ability to visualize objects in three-dimensional space, and it has a known factor structure. People scoring high on this test are good at mechanical jobs requiring visual mental images of three-dimensional objects. The parallel-form reliability of the SV is .89. Validity studies (Ruch & Ruch, 1963) have demonstrated that the SV is related to success as a wholesale salesman (r=.70), an aircraft manufacturing supervisor (r=.35), machine shop trainee - aircraft (r=.48), machine
shop student - junior college ($r = .48$), precision assembly trainee - aircraft ($r = .34$), structures assembly trainee - aircraft ($r = .55$), electronic troubleshooter ($r = .61$), engineering drafting student ($r = .73$), and many other occupations.

The Betts and the Grdn, the only known tests of visual imagery (also the ones used in nearly every study of visual mental imagery) were used for comparison with the visual subtests that were created in this study. The SOV and the SV were used for comparisons of the new tests with instruments having known and adequate psychometric data (particularly reliability and validity) and reliance on the ability to image visually. The number of tests meeting these criteria is very few, and the SOV and the SV seem to be the best of those that do exist.

**Procedure**

**Pilot-Work**

1. The imagery literature was reviewed to determine what the most used and most reliable imagery assessment devices were. Clearly, Sheehan's (1967a) short form of the Betts QMI (Betts) (designed to measure vividness) and Gordon's test of image controllability (Richardson, 1969) were chosen for use by the overwhelming majority of researchers. The reliabilities of these tests were generally found to be in the high .70's and low .90's.

2. The writer confirmed these reliabilities in two separate pilot studies.

3. The Betts and the Gordon tests served as models for the new items to be used in the proposed alternate-form tests.
The form of the items on each test was combined in each new item. To explain further, the Betts test measures vividness with a rating scale of from one to seven (Vividness = 1, 2, 3, 4, 5, 6, or 7 (high)). The Gordon test measures controllability on a scale from zero to two (no=0, unsure=1, yes=2). An example of the new items is:

Can you visualize an army jeep?
1-no 2-unsure 3-yes
Vividness 1 2 3 4 5

The response weights are 1 to 3 for controllability and 1 to 5 for vividness. This allows the use of IBM computer forms for subject responses.

4. A total of 280 new test items was constructed using the above method; 140 items were used in each form of the test. For each form, there were 27 visual items, 24 auditory items, 20 olfactory items, 20 gustatory items, 21 tactile items, 12 somesthetic items, and 16 kinaesthetic items.

5. Next, the large number of parallel items for each test form was administered to a large sample of subjects (283 subjects for Form A and 227 subjects for Form B).

6. The criteria for item selection were empirical. Items chosen for use in this study generally met four criteria:

   a. To ensure that each item was highly related to both vividness and controllability, the majority of selected item pairs were each correlated with total factor scores (Vividness and Controllability) at .5 or higher. (The actual range was about .42 to .73.) For example, the items in the item-pair (A) "Can you see a horse standing alone" and (B) "Can you see an elephant standing alone," both correlate over .5 with the total factor scores of vividness and controllability.
b. To select items that would hopefully result in convergent and discriminant validity, the difference between the item-total opposite factor correlation and the item-total modality factor correlation for each pair of parallel items had to be above a certain criterion: Visual above .18, auditory above .16, olfactory above .18, gustatory above .18, tactile above .16, somesthetic above .16, kinaesthetic above .17. For example, using the same item-pair as in criterion a, both differences for controllability are above .2, and both differences for vividness are above .29. This contrast was adopted to ensure two factors of vividness and controllability as distinct as possible.

c. Since one goal was to obtain highly comparable alternate-form tests, items were also selected so that the difference, between the difference between the item-total factor correlation and the item-total modality factor correlation for each parallel item on Form A and Form B, had to be small (.2 maximum). For example, continuing with the same item-pair, the differences used in criterion b could differ in magnitude no more than .08 for controllability and no more than .1 for vividness. The criterion was empirical proof that similar items were working similarly as is necessary for a satisfactory test.

d. To ensure that within modalities meaningful vividness and controllability scores could be obtained, the difference between the item-total modality vividness correlation and the item-total modality controllability correlation for both factors (Vividness and Controllability) were set at: Visual, .08 for controllability (C), .1 for vividness (V); Auditory, .08 for C, .1 for V; Olfactory, .06 for C, .06 for V; Gustatory, .1 for C, .1 for V; Tactile, .08 for C, .1 for V; Somesthetic, .7 for C,
.7 for V; Kinaesthetic, .1 for C, .1 for V. For example (using (A) and (B) in criterion a), on the controllability dimension, both differences are above .9 for visual controllability and on the vividness dimension above .13 for visual vividness.

e. Out of the 280 items, 172 were chosen: For each test form, there were Visual 16, Auditory 13, Olfactory 11, Gustatory 13, Tactile 10, Somesthetic 10, Kinaesthetic 13. Thus there were 86 items per test form.

The purpose of this procedure was to select each item so that: 1) on the vividness dimension, it is correlated highly with the total vividness factor and minimally with the total controllability factor; 2) on the controllability dimension, it correlated highly with the total controllability factor and minimally with the total vividness factor; 3) on the modality vividness dimension, it correlated highly with the total modality vividness factor (for example, visual vividness, auditory vividness, etc.) and minimally with the total modality controllability factor (for example, visual controllability, auditory controllability, etc.); and 4) on the modality controllability dimension, it correlated highly with the total modality controllability factor and minimally with the total modality vividness factor.

A linear combination of the items meeting these criteria should comprise subtests yielding scores for vividness and controllability in each of seven sensory modalities, a general vividness score, a general controllability score, and a total imagery score.

The pilot studies suggested that such a test of self-reported imaging behavior was possible. Each group of items was then combined into two parallel tests of self-reported imaging ability. Both forms were then admin-
istered in random order to the same subjects in the same experimental ses-

Data Analysis

Basic psychometric analyses were performed on both alternate-form tests. It is suggested that the reader refer to the Data Analysis Matrix in Figure 1 for a better understanding of the analyses. Figure 1 is a graphic model of the correlation matrix composed of the intercorrelations of modality-factor subtests (VCV, VVA, BCO, BVG, etc.), total factor scores (ACCT, AVVT, BCCT, BVVT), total test-form scores (AGT, BGT), and the sum of the two total test-form scores (ABGT). The letters and numbers within the matrix are used to identify homogenous (related) areas and individual correlations within the matrix. The letter combinations along the side and bottom of the matrix may be read as follows: Combination ACT is the Form A total tactile modality (T) subtest score on the controllability factor (C); Combination BVO is the Form B total olfactory modality (O) subtest score on the vividness factor (V); Combination ACCT is the Form A total controllability score across modalities; Combination BVVT is the Form B total vividness score across modalities; Combination AGT is the sum (grand total - GT) of the total vividness and controllability factors in test Form A.

Among the analyses performed were the following:

1. Analysis of Scale Homogeneity

   a) Cronbach's Alpha was determined for each of the controllability and vividness subtests in each of the sensory modalities.

   b) Alpha was also determined for the total vividness, total controllability, and grand total test scores.
Figure 1. Data analysis matrix

Note: In three-letter combinations, the first letter is the test form (A or B), the second letter is the factor being assessed (Vividness-V or Controllability-C), and the third letter is the sensory modality (e.g., V-visual, A-auditory, etc.). If the second and third letters are GT, it is the total score for the test form. Four-letter combinations are total factor scores.
These Alpha reliabilities were placed in diagonal A of Figure 1. For example, the reliability of the visual controllability subtest on Form A (ACV) would be the top left correlation in the matrix diagonal (the intersection of ACV and ACV). Diagonal B was also an index of reliability, namely parallel form reliability, and it was expected that the correlations would be about equal in magnitude to those in Diagonal A.

2. Analysis of Scale Convergence and Discrimination

All subtests and total scores were then intercorrelated within test forms and between test forms. It was expected that the vividness and controllability subtests would not be highly correlated both within and between subtests. This would mean that in Figure 1 the correlations should be relatively low in areas 5, 6, 7, 8, 9, 10, 13, and 14. In addition, the vividness subtests would be more highly correlated with other vividness subtests than with the controllability subtests. It follows that the controllability subtests would be more highly correlated with other controllability subtests than with the vividness subtests. This means that the correlations in areas 1, 2, 3, 4, 11, 12, 15, and 16 should be moderately large in magnitude and higher than those in areas 5, 6, 7, 8, 9, 10, 13, and 14. Both main factors (vividness and controllability) should not be highly correlated, therefore, correlations \( h_n, k_a, k_n \), and \( j_r \) should be low and much lower than correlations \( a_g, h_a, i_a, k_a, k_r \), and \( j_n \).

3. Factor Analysis

Factor analysis is an important tool in the explication of constructs. The 28 modality-factor subtests (14 from each of the new tests) were factor analyzed with estimates of communality in the diagonal of the correlation
matrix. This procedure removes the presumed unique variance of each variable and only analyzes the remaining portions of the variances. In this way, the factors are specified entirely in terms of the common variance among variables. The resulting factor matrix was then submitted to a varimax rotation. Varimax is a method of orthogonal factor rotation designed to simplify the columns of a factor matrix, which is equivalent to maximizing the variance of the squared loadings in each column.

4. **Validity estimate of the visual imagery subtests**

A subsample of 152 was also administered the Betts, the Grdn, the SOV, and the SV. The Betts and Grdn are, to the writer's knowledge, the only prior tests for studying visual mental images. It was hoped that the new visual vividness subtests (AVV, BVV) would be more highly correlated with the Betts than the Grdn. In addition, the new controllability subtests (ACV, BCV) were expected to be more highly correlated with the Grdn than the Betts. This would suggest convergent and discriminant validity.

The SOV and the SV both employ visualization and are more or less established tests in industry and counseling. The new visual subtests (ACV, AVV, BCV, BVV) and the older well-established tests of visual imagery (Betts, Grdn) were compared with respect to their relationship with the SOV and the SV. It was hoped that this comparison would establish some tentative estimates of external validity for the new tests, as well as demonstrate their superior utility (in a predictive sense) by being more strongly related with the SOV and the SV than the older Betts and Grdn.
5. **Normative Data**

General normative data by sensory modality, factor (vividness and controllability), and sex was to be gathered. It was hoped that this would show both test forms to be highly comparable and also reveal any sex differences should some exist. Sex differences were not expected.
Chapter IV.  

Results

The following basic psychometric analyses were performed on both alternate-form tests:

1. **Analysis of Scale Homogeneity**

   a) Cronbach's Alpha, a measure of internal consistency based on the average correlation among test items, was determined for each of the controllability and vividness subtests in each of the sensory modalities. Alpha was also determined for the total vividness, total controllability, and grand total test scores. The Alpha reliabilities should be placed in diagonal A of Figure 1 and are presented in Table 1. In both Form A and Form B, the lowest Alphas were for controllability and vividness of somesthetic imagery: ACS=.68, AVS=.78, BCS=.71, BVS=.79. In both Form A and Form B, the highest Alphas of the modality subtests were for controllability and vividness of gustatory imagery: ACG=.86, AVG=.90, BCG=.88, BVG=.91. The Alphas for the total factor scores of controllability and vividness, as well as the grand total test scores, were identical for both test forms: ACCT=.95, AVTT=.97, AGT=.92, BCCT=.95, BVTT=.97, BGT=.92. The identical Alphas suggest that the alternate forms have identical levels of internal consistency, while the magnitude of the Alphas supports the high reliability of the tests.

   b) Diagonal B of Figure 1 is also an index of reliability, namely parallel form reliability, that can be used to check the validity of the Cronbach Alphas. The reliability estimated from internal consistency is often quite close to the reliability estimated from correlations between
Table 1.
Cronbach Alphas for Subtests and Total Scores: Diagonal A

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</table>

alternative forms. The actual correlations in diagonal B are presented in Table 2. The magnitude and relative size of the correlations are markedly similar to the Alphas, which suggest that the Alphas are accurate representations of scale-test reliability.

2. **Analysis of Scale Convergence and Discrimination**

All subtests and total scores were intercorrelated within test forms and between test forms. The major areas of intercorrelation are displayed in Figure 1, and the actual correlations are presented in Tables 3, 4, and 5. The various controllability and vividness subtests were not highly correlated both within and between test forms. This is reflected in the relatively low correlations in areas 5, 6, 7, 8, 9, 10, 13, and 14 of Figure 1.
### Table 2.
Parallel Form Reliability: Diagonal B

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(see Tables 3, 4, and 5 for the actual numbers). This lends support to the notion of different modality and different factor discrimination between the various subtests.

In addition, vividness subtests were generally more highly correlated with other vividness subtests than with controllability subtests. Also, controllability subtests were generally more highly correlated with other controllability subtests than with vividness subtests. This is demonstrated by the correlations corresponding to areas 1, 2, 3, 4, 11, 12, 15, and 16 of Figure 1 (see Tables 3, 4, and 5 for the actual numbers) generally being greater in magnitude than those in areas 5, 6, 7, 8, 9, 10, 13, and 14. This lends support to the notion of same modality and same factor convergence among the various subtests.
Table 3.
Intercorrelations of Subscales of Form A

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Discriminant and convergent validity are also supported by the fact that (referring to Figure 1) correlations $hn$ (.78), $kg$ (.81), $kn$ (.74), and $ir$ (.73), correlations between the total vividness and total controllability scores both within and between the test forms, are much lower than correlations $kr$ (.92, the correlation between total vividness scores for forms A and B), $in$ (.91, the correlation between total controllability scores for forms A and B), $ag$ (.95, ACCT Alpha), $ha$ (.97, AVVT Alpha), $ja$ (.95, BCCT Alpha), $ka$ (.97, BVVT Alpha). Therefore, the correlation between both main factors (controllability and vividness) on the same test form was less (discriminant validity) than the correlations between the same factors on the different test forms (convergent validity).

3. Factor Analysis

A factor analysis was performed on the 28 modality-factor subtest scores (14 from each test form). The type of factor analysis was a principle factor solution with the largest off-diagonal as a communality estimate and employed the orthogonal varimax rotation. With this type of analysis, the main diagonal of the correlation matrix is entered with estimates of communality.

Seven factors were extracted (see Table 6) and named on the basis of those subtests having the highest loadings on each factor: Factor I, Visual Imagery, accounted for approximately 11% of the rotated common variance and is generally composed of those subtests dealing with vividness and controllability of visual images on both Form A and Form B; Factor II, Olfactory Imagery, accounted for approximately 12% of the rotated common variance and is generally composed of those subtests dealing with vividness
Table 6.
Factor Analysis of Form A and Form B Subtests

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| S       | 3.17   | 3.34   | 3.34   | 4.16   | 2.71   | 3.71   | 3.55|
| V_i     | 11     | 12     | 12     | 15     | 10     | 13     | 10 |

a Communalities.

b Sum of squared factor loadings.

c Percent of total variance associated with factor.

* Largest factor loadings.
and controllability of olfactory images on both Form A and Form B; Factor III, Somesthetic Imagery, accounted for approximately 12% of the rotated common variance and is generally composed of those subtests dealing with vividness and controllability of somesthetic images on both Form A and Form B; Factor IV, Kinaesthetic-Tactile Controllability, accounted for approximately 15% of the rotated common variance and is generally composed of those subtests dealing with controllability of kinaesthetic and tactile images on both Form A and Form B; Factor V, Gustatory Imagery, accounted for approximately 10% of the rotated common variance and is generally composed of those subtests dealing with vividness and controllability of gustatory images on both Form A and Form B; Factor VI, Kinaesthetic-Tactile Vividness, accounted for approximately 13% of the rotated common variance and is generally composed of those subtests dealing with vividness of kinaesthetic and tactile images on both Form A and Form B; Factor VII, Auditory Imagery, accounted for approximately 10% of the rotated common variance and is generally composed of those subtests dealing with vividness and controllability of auditory images on both Form A and Form B. Taken together, the seven factors accounted for approximately 82% of the rotated common variance. The eigenvalues of the seven unrotated factors were 15.13, 2.25, 1.89, 1.84, 1.32, 1.06, and .72, respectively.

The actual factor loadings, communalities, and percentages of variance accounted for by the factors are presented in Table 6. Overall, these data suggest that each modality subtest is measuring content similar to other subtests in the same modality but different from the content measured by subtests in other modalities. The modalities appear to be more important than either vividness or controllability.
4. **Visual Imagery Subtest Validity**

Of the total sample of 350, a subset of 152 subjects was administered four additional measures related to or employing visual imagery. These were the Survey of Object Visualization (SOV) (Miller, 1955), Test 5 - Space Visualization from the Employee Aptitude Survey (SV) (Ruch & Ruch, 1963), the Sheehan version of the vividness of visual imagery subtest of the Betts QMI (Betts) (Betts, 1909), and the Gordon Test of Visual Imagery Control (Grdn) (Gordon, 1949). The relevant correlations dealing with visual subtest validity are present in Tables 7, 8, and 9.

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Note: Males N=54, Females N=98. The Grdn, the ACV, and the BCV are tests of visual controllability, while the Betts, the AVV, and the BVV are tests of visual vividness.

**p<.01.

The main criterion measures were the SOV and the SV. On the SOV, the mean score for males was 27.61 (standard deviation = 6.70), and the mean score for females was 25.08 (standard deviation = 6.35). Significant sex differences on SOV performance were indicated by t(42) = -2.31, p<.05. On the SV, the mean score for males was 29.43 (standard deviation = 8.45), and
Table 8.
Visual Validity Coefficients

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Note: Males N=54, Females N=98. The Grdn, the ACV, and the BCV are tests of visual controllability, while the Betts, the AVV, and the BVV are tests of visual vividness. The SOV (Survey of Object Visualization) and the SV (Test 5 - Spatial Visualization) are criterion measures employing visualization.

* p<.05.

** p<.025.

the mean score for females was 24.49 (standard deviation = 8.37). Significant sex differences on SV performance were indicated by t(42) = -.3.47, p<.01. After determining that there were significant sex differences such that males exceed females on these two variables, it was decided that the validity data should be evaluated by sex groups instead of a combined group.

For males, the SOV and the SV were correlated .30, and for females they were correlated .54. However, the correlations between the Betts and the Grdn for both male and female groups were similarly low (.32 for males and .30 for females). The above suggests that there is a consistent relationship between the Betts and the Grdn for both sexes, while the relationship between the SOV and the SV differs by sex.
Table 9.

Miscellaneous Validity Coefficients

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Note: Males N=54, Females N=98.
Next, the visual subtests of Form A and Form B were compared with the Betts and the Grdn since the latter are the most widely used and accepted tests of visual imagery (data in Table 7). In comparing the visual vividness subtests (AVV and BVV) and the visual controllability subtests (ACV and BCV) with the Betts (a measure of visual vividness), it was first noted that the magnitude of the correlations was greater for males than females. In addition, except for the BVV female coefficient, the vividness subtests of Form A and B were more highly correlated with the Betts than were ACV and BCV. This was expected and adds some validation support.

In comparing the visual vividness subtests (AVV and BVV) and the visual controllability subtests (ACV and BCV) with the Grdn (a measure of visual controllability), it was first noted that the magnitude of the correlations was greater for females than for males. In this case, overall the ACV, AVV, BCV, and BVV all were correlated with the Grdn at about the same moderately low level. The highest coefficients were for females on the ACV and the BCV. The similarity of all eight correlations is hypothetically due to controllability being assumed to exist to some extent whenever vividness is dealt with. Controllability may be conceptualized as a precondition or the step before vividness. Another possible factor in the correlation similarity also may be the fact that both the vividness and controllability scores on forms A and B employ the same items. Overall these results add tenuous support to visual subtest validity.

Further data concerning visual subtest validity are presented in Table 8. Both the SOV and SV employ visualization. If the tests just developed are reasonable tests of this construct (visual imagery), they should be at least as related to the SOV and the SV as are the Betts and
the Grdn (the older well established tests). If for some reason a second measure of visual imagery was needed to accompany the SOV or the SV, Table 8 would enable one to make the best decision through its comparison of the correlations between the SOV and the SV with the Betts, Grdn, ACV, AVV, BCV, and BVV. The results here again are differentiated by sex. For males, the Grdn, the ACV, and the BCV have similar positive correlations with the SOV, all greater in magnitude than the Betts correlation. For females, the relationship between ACV, AVV, BCV, and BVV is greater than either that of the Betts or the Grdn. For males, the Grdn and the ACV, AVV, BCV, and BVV subtests have similar positive correlations with the SV, all superior in magnitude to the Betts correlation. For females, however, the Betts has a greater correlation with the SV than any of the ACV, AVV, BCV, or BVV subtests. The subtests, however, have a greater relationship with the SV than does the Grdn. The above contributes some evidence to the notion of visual subtest validity; however, these results are qualified by sex.

Table 9 permits some additional, though tenuous, support for the validity of the visual subtests. In most cases, the visual subtests (ACV, AVV, BCV, and BVV) had correlation coefficients of greater magnitude with the Betts, Grdn, SOV, and SV than subtests of other sensory modalities. For example, with females the Betts is more highly correlated with AVV (.48) and BVV (.56) than ACG (.18) or BCG (.09). This suggests that the construct being tapped by the visual subtests is more similar in content to other visual tests than is the content of subtests dealing with other sensory modalities. This evidence lends some support to the notion of convergent and discriminant validity for the visual subtests.
5. Normative Data

General normative data by modality, factor, and sex are presented in Table 10. As can be seen, there appear to be no sex differences, and the test forms appear to be very nearly equivalent. In many cases, the modality-factor subtest means and standard deviations are identical across test forms. Where they are slightly different across test forms, most are identical by sex. It is also worthy of note that the many identical means and standard deviations for the two text forms are evidence for considering the two tests (A and B) as parallel forms.

Table 10.
Normative Data by Test Form and Sex

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Note: Males N=129, Females N=221.
In summary, the results lend support to the notion that Form A and Form B are alternate-form measures that enable simultaneous measurement of vividness and controllability in at least six sensory modalities. When subjects respond on IBM response sheets, they are untimed, paper-and-pencil, self-report, computer-scored instruments. It appears that forms A and B are reliable psychological measurement instruments, and evidence is presented suggesting at least minimal validity for the visual subtests. Further research is required to establish valid uses for all subtests.
Chapter V.
Discussion

The results seem to suggest that the parallel-form test measures are strictly comparable, reliable, have a known factor structure, and permit simultaneous measurement of vividness and controllability in at least six sensory modalities. It can be inferred from the work on validity that the visual subtests are moderately related to those already in existence and that they have some improved psychometric properties. Additional study of the validity of this instrument is required.

When the pattern of correlations in Table 7 is noted, it is evident that while the Betts (a test of visual vividness) is generally more highly correlated with subtests of visual vividness (AVV, BVV) than with subtests of visual controllability (ACV, BCV), the Grdn (a test of visual controllability) is correlated at about the same magnitude with both controllability and vividness subtests (ACV, AVV, BCV, BVV). While initially this would appear to be a problem, it may be accounted for when the relationship between controllability and vividness is put into perspective. Whenever one deals with vividness of imagery, to some extent controllability is automatically assumed. In other words, if a person describes how vivid a mental image is, it is taken for granted that he has in fact produced the image. The ability to produce a target image is basically what the controllability factor taps. In the broad perspective, controllability also concerns the ability to manipulate, modify, and prolong an image once it is produced. When the vividness of a particular image is described, however, it is taken for granted that the target item was controlled in that it was
produced. Controllability may be conceptualized, therefore, as the first stage of imagery or the stepping stone that leads to image vividness. It is proposed that this relationship between factors is very probably the main cause of the similar Grdn correlations. The moderate correlations between the AVV and the BVV with the Grdn seem to reflect this factor relationship.

Taking this relationship into account, if it is necessary to assess visual imagery and there is time to give only one subtest, the most conservative approach would be to give a vividness subtest because with the vividness subtests some ability to control mental images can be assumed. When using only a controllability subtest, no inference as to vividness can be made. Naturally, the goals of the research study have to be weighed. If controllability is of primary interest, then a controllability subtest should be selected since the controllability evidence gained from a vividness subtest is minimal.

The validity coefficients ranged in magnitude from low (.00) to moderate (.31). This low relationship between variables was expected due to the differences in content. For example, the SV involved subjects' peering into a two-dimensionalized stack of rectangular blocks and making a determination of how many other blocks each block touched. The SOV required subjects to tell what a two-dimensional pattern would look like when folded into a three-dimensional shape. The Grdn involved manipulating a single image, while the Betts drew heavily on producing memory images. The items comprising the visual subtests on Form A and Form B were much broader in content and even included fantasy images. The magnitude of the correlations, however, was overall not as important as their pattern. Interest
was primarily in how the new instruments compared with the Betts and the Grdn in their relationships with the SOV and the SV.

The results of this study suggest that both Form A and Form B have some improved psychometric properties over other tests of mental imagery. First, the Alpha reliabilities are quite high, indicating that the subtests and most certainly the general factor scores (ACCT, AVVT, BCCT, BVVT) are at very high levels of internal consistency (e.g., ACCT=.95, BVVT=.97, etc.). Second, some of the new subtests concern imaging modalities for which no assessment device had previously been created, for example, tactile, auditory, gustatory, olfactory, kinaesthetic, and somesthetic controllability. Third, there are alternate forms of each subtest, where all previous devices (Betts, Grdn) have existed in one form only. Fourth, both Form A and Form B have a known factorial composition which demonstrates which tests share common variance and, therefore, seem to be measuring the same construct. This helps one infer the nature of the construct being tapped with some confidence. Fifth, since either form requires only about 20 minutes to administer, a large amount of image data can be obtained quickly. Finally, the test answers can be computer scored.

**Implications**

**Clinical Implications**

There are several clinical implications of this study. For one, counselors have in their therapeutic arsenal a range of techniques that directly employ mental images. Such techniques include systematic desensitization, implosive therapy, covert sensitization, and many others. It has been the writer's experience that the client's ability to produce mental
images is rarely assessed, while the techniques are routinely applied. The instruments developed in this study may be found useful in obtaining a quantified picture of a therapy client's imaging ability in a very short time. As a consequence of this, therapeutic imagery techniques could then be tailored to the unique imaging capacity of the client. For example, in systematic desensitization, it is possible to achieve the same results using modalities other than the visual, but if it is not known that the client can image in other modalities, a potentially effective intervention may be abandoned due to ignorance. Finally, knowledge of the parameters of a client's imagery ability may improve the psychologist's understanding of the patient's pathological experiences. Since a criterion for confinement in a mental hospital is hallucinations, knowing that a client has an exceptional ability to produce vivid mental images has implications for therapy. In addition, knowing that a patient has strong tactile and/or somesthetic imagery is valuable knowledge in the treatment of psychosomatic illness.

Research Implications

The implications these tests have for imagery research are more numerous than those in the clinical area. (1) These tests are an advance in overcoming the measurement obstacle in imagery research. They seem to be an improvement over prior instruments, and they fill the vacuum where tests were needed but none existed. (2) Lindauer (1969) had previously commented that the bulk of imagery research had dealt with the visual modality and minimally with auditory imagery. Other sensory modalities seemed to have rarely been investigated. This might very well have been due to the unavailability of tests dealing with other sensory modalities or to the
poor quality of those that did exist. Form A and Form B are general tests whose subtests appear to be psychometrically viable and whose content covers the whole known range of imaging modalities. (3) McKellar (1973) has deplored the neglect in imagery research of controllability. It is believed that a major reason for this is that only one viable device for the assessment of controllability has been in existence, the Grdn. Forms A and B offer a combined total of 14 modality-specific tests of controllability and two general tests of controllability (ACCT and BCCT). (4) Prior to this investigation, few research studies have dealt with controllability and vividness simultaneously. In addition, the Betts and the Grdn each measured only one dimension of imagery. It may prove to be more economical to use Form A or Form B to measure both factors simultaneously. (5) Each test form can be used as a whole or broken down into the specific modality subtests of interest. (6) It is possible to be conservative by combining the parallel subtests from both forms for any one modality, thereby doubling scale length and obtaining more reliable score. This option afforded by the parallel forms may occasionally be found useful. (7) In view of the paucity of assessment devices existing prior to this time, there has been only limited research into individual differences in imaging behavior. These scales potentially offer the possibility of researching a broad range of individual difference variables. (8) For psychologists doing research in psychopathology, forms A and B may be found to be good instruments to explore the parameters of the hallucinatory behavior often occurring in certain clinical groups. (9) Images have been found to be important in memorization (Paivio, 1969, 1971a; Sheehan, 1972b). If it is required that certain subject matter be learned by students and that the various content
areas of this subject matter will best be learned by presentation to or through different sensory modalities, then forms A and B may help the educator better tailor subject presentation to the abilities of the students. For example, learning to paint in oils requires a sensitive manipulation of the brush. Instruction that employs tactile and kinaesthetic imagery may very well enhance an art student's learning. (10) Rehm et al. (1974) has complained that the majority of research has examined imagery as an independent variable. Now that there are parallel-form tests, it is possible for imaging behavior to be studied as a dependent variable as well. (11) With the parallel forms, a much better job can be done in measuring experimentally manipulated or developmental changes in imaging ability. For example, Taylor (1973) states that training can increase both vividness and controllability of imagery. Forms A and B might be employed as pre- and post-tests to test Taylor's hypothesis. As can be seen from the above, the potential implications of these tests for imagery research are considerable.

Theoretical Implications

There are some theoretical implications of this study as well. First, there have been some questions about whether introspection and self-report can or should be studied. Writers such as Kessel (1972) and Natsoulas (1967) have protested that experiential data such as self-report can and should be systematically studied. It may be inferred from the results of this study that self-report of imaging behavior could be systematically investigated with these highly reliable test instruments. Second, Bugelski (1971) has stated that if people can report and describe their imagery,
they must be responding to some internal stimulus. Even though direct observation of this stimulus cannot directly be made by a second person, forms A and B may allow an indirect yet quantified view of the person's mental images. The performance of these tests (e.g., their internal consistency and factor structure) might lend some support to Bugelski's claim of an internal stimulus. Third, the results may lend some tenuous support to McMahon's (1973) theoretical statement that a motivated man knows precisely what he wants despite the fact that he cannot see it. There may very well be some internal representation of the object that is sought. For example, when a person decides that he wants an egg for breakfast, the gustatory image of an egg may be a prime factor in changing thought into action. Also, how does this person know that he has found an egg when he sees one? Is a memory image of an egg being employed to distinguish an egg from an apple or an orange? Fourth, the results of this study do not agree with the notion that mental images are not subject to the influence and direction of the imager (Bugelski, 1971). The controllability subtests met some high psychometric standards and as such seem to indicate that mental images can be controlled to some extent. The construct of the controllability of mental images would have been suspect if the correlations between the alternate forms of the various controllability subtests had not been so high. This did not seem, however, to be the case.

Fifth, the results of this study agree with claims by Betts (1909), Paivio (1971a), and Sheehan (1972b) that mental images differ in sensory mode. The most striking supporting evidence was the factor analysis which revealed a factor structure based primarily on the sensory modalities.

Sixth, the findings of Evans and Kamemoto (1973), Hertz (1972), and
Richardson (1969) that tactile imagery is the most reliably measured image modality was not supported by this study. On forms A and B, gustatory mental imagery was the most reliably measured image modality. Though there is no clue for an explanation of this divergent finding in the results, theoretically the superior performance of the gustatory subtests may be due to gustatory images being more heavily reinforced in daily life, while visual and auditory images may be suppressed due to their popular association with psychopathology. Seventh, researchers such as McLemore (1971) have some data supporting the assumption that vividness is a unitary attribute across sensory modalities that is distinguishable from controllability. In this area, the results of this study are mixed. Overall, the correlations within the controllability subtests and within the vividness subtests are higher than those between vividness and controllability. The factor structure of the tests suggests that sensory modality is more salient than either vividness or controllability. However, it is the author's impression that it is safe to assume that while vividness and controllability are correlated, they yet have some unique distinct attributes as well. The evidence that seems to support this assumption is the performance of the total factor scores (ACCT, AVVT, BCCT, BVVT). These major subtests are psychometrically at least as adequate as the modality subtests. Eighth, researchers such as Singer (1966) claim that imagery is a widespread phenomenon. However, to the writer's knowledge, the true extent or complexity of imaging behavior in the general population has yet to be seriously investigated. Forms A and B might be used profitably in this line of research. Ninth, theories of imagery (some of which were presented in Chapter Two) have begun to be proclaimed at an increasing rate. Where
prior to this time instruments were not available to test these theories, forms A and B seem to have potential utility in theory validation.

Finally, Griffitts (1924) and others strongly imply that the dominant imagery modality should be considered in vocational counseling and is a criterion for success in some occupations. Forms A and B might be used to test this hypothesis in two ways: First, they would enable the dominant modality to be assessed and second, they could be used in studies to determine if in fact the ability to image in a certain modality is related to occupational proficiency and success.

Some Limitations of This Study

The limitations of this study should be mentioned. An initial limitation is the population. The overwhelming majority of subjects was between 18 and 21 years of age and students in introductory psychology courses at Iowa State University. In addition, the ratio of females was two to one. The generalizability of the results of this study to other populations is moot until other studies with different subject populations can be done. A final limitation is that for the majority of subtests (other than those dealing with visual imagery), there are no other instruments with which to compare them. And even where such possibilities do exist, they are inadequate.

Another limitation of this study is the limited evidence concerning validity. Additional research is very much needed to establish the external validity of Form A and Form B. Specifically, studies need to be carried out in five areas: (1) It needs to be determined if there are valid and practical uses for the subtests in each sensory modality. The results
of the study make a good case for the reliability of the various modality-factor subtests, but valid uses for them need to be established next.

(2) Test-retest reliability over varying time periods needs to be tested. It would be valuable to determine if the ability to image holds constantly over time for all sensory modalities and factors or if one or all subtest scores vary to some extent over time. It is also of interest if and/or how a person's internal and external environment affects his ability to produce and manipulate mental images. (3) It is hoped that the validity of this instrument can be established in counseling/clinical situations. For example, an impressive addition to the validity of forms A and B would be the capacity to predict candidates who have a high probability for success in therapies using mental imagery (such as systematic desensitization, covert reinforcement, etc.). (4) Additional research is also needed to determine the modal fakability as well as investigate response biases such as acquiescence and social desirability.

Finally, the following general lines of research into mental imagery are frequently cited in the literature. It is believed that forms A and B could have a potential role in these areas:

1. Many psychologists have called for more individual differences research (Bartlett, 1921; DiVesta et al., 1971; Gale et al., 1972; Horowitz, 1972; Kessel, 1972; Leibovitz et al., 1972; Morris & Gale, 1974; Pylyshyn, 1973; Spodak, 1973).

2. Following the lead of Gordon (1949, 1950), Jaensch (1930), Richardson (1969), and Sheehan (1972a), more research needs to be done on the relationship between mental imagery and personality and psychopathology.
3. Is the ability to image a stable attribute of personality or is it subject to change over time or through direct attempts to modify it? These questions demand further research.

4. Perry (1973), Sutcliffe (1961), and Sutcliffe et al. (1970) have determined that vividness and hypnotic susceptibility are positively correlated. The details of the parameters of this relationship need to be investigated in much more detail.

In summary, this study has produced two alternate form test instruments that have expanded content and improved psychometric properties over other tests purporting to measure the ability to image. The assessment devices that resulted from this study have been shown to have potential theoretical, experimental, and clinical implications. With the conclusion of this study, two reliable tests have been produced that compare favorably with basic psychometric standards. However, much work in the area of criterion-related validity is yet required.
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Appendix.
Form A and Form B

Copies of the Survey of Mental Imagery: Form A or the Survey of Mental Imagery: Form B may be obtained from the writer at the following address:

Joseph E. Switras
307 Central Avenue
Metuchen, New Jersey 08840