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Group process versus social influence in evidential reasoning about an empirical stimulus

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GROUP PROCESS VERSUS SOCIAL INFLUENCE IN EVIDENTIAL REASONING ABOUT AN EMPIRICAL STIMULUS.

by

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Abstract

GROUP PROCESS VERSUS SOCIAL INFLUENCE

IN EVIDENTIAL REASONING ABOUT AN EMPIRICAL STIMULUS.

by

Gregory Bovasso

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Evidential reasoning is defined here as the verification of an empirical fact by perceptual inference influenced by sources external to an empirical stimulus. The present research tested the effects of both social influence and group processes on evidential reasoning about an ambiguous empirical stimulus, the Muller-Lyer illusion. Social influence was defined as the unilateral influence of a source on a target. Group process was defined as the mutual influence of subjects on each other. Individuals involved in group discussion made significantly more veridical perceptions of an ambiguous stimulus than individuals alone (F=4.32, df=1,49, p<.05). Groups and individuals exposed to a source of social influence made significantly less veridical perceptions than groups and individuals not exposed to an influence source (F=5.04,

df=2,49, p<.05). These results suggest that consensus formed in discourse is a rational process by which empirical reality is validated, unless biased by influence external to that discourse. The implications of the results for scientific evidential reasoning are also discussed.

Preface

The present research investigates social influence on the perceptual inferences used in the verification of evidence. Evidential reasoning is defined here as the psychological process by which an empirical phenomenon acquires the status of a fact in social reality. This process involves perceptual inferences about empirical evidence which may be influenced by factors external to the evidence itself. Evidential reasoning may produce a more veridical perception when it is the product of group discussion rather than merely a response to an external agent of influence. Thus, evidential reasoning is examined here as a process by which empirical reality is socially constructed (Berger and Luckmann, 1966).

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Introduction

The process by which people justify evidence as factual is commonly taken for granted unless perception of the evidence is incongruous with prior expectation. In a study of evidential linguistic usage, Chafe (1986) found that oral and written English make relatively little use of words which justify factual claims by referring to perceptual evidence. Chafe found that justification in oral and written language was overwhelmingly performed by statements referring to prior expectations (e.g., "of course", "oddly enough"). Statements referring to evidence acquired either by direct observation (e.g., "looks like") or by induction (e.g., "obvious") were less frequently used than references to evidence derived by deduction (e.g., "should", "presumably") or by beliefs involving information other than the evidence (e.g., "I guess", "I think") .

Chafe found that people used indirect references to evidence in oral and written language in which the justification of evidence also referred to expectations. If observations are incongruous with expectations, then directly observed evidence may become more important than indirectly derived evidence in the discursive justification of factual claims. Thus, contradictions of factual

expectations by incongruous perceptual stimuli, or by information incongruous with stimuli, may initiate evidential perceptual processes.

The psychological literature related to evidential reasoning (Pennington & Hastie, 1986; Downing, Sternberg, & Ross, 1985; Schum & Martin, 1982; Schustack & Sternberg, 1981; Borgida, 1978; Mynatt, Doherty, & Tweney, 1978; Schum, 1977, Podeschi & Wyer, 1976) has studied the ways in which individuals reason about presupposed facts (e.g., information integration, Bayesian, Poisson process stochastic, and sequential weighting models). However, little attention has been given in this literature to the ways in which initial observations acquire their veridical status. Inductive reasoning proceeds from observations which are granted at least a tentative status as facts. Similarly, deductive reasoning cannot arrive at factual conclusions unless they are based on premises which are factually correct. Hence, the first step in the evidential reasoning process involves the verification of observations and/or premises as factual.

The results of a study by Laughlin (1988) suggest that evidence is prerequisite to logical hypotheses testing in the establishment of factual knowledge by groups. Laughlin (1988) studied the group performance of inductive reasoning in a card playing task. Both majorities and minorities

within groups improved their performance by exchanging evidence but not by exchanging hypotheses. The majority performed better than the minority using similar strategies to the minority. The majority also exerted more influence on the minority through the exchange of evidence but not through the exchange of hypotheses. Further, once the correct hypothesis was proposed in group discussion both majorities and minorities eventually adopted it.

However, Laughlin did not examine the process by which that evidence was regarded as valid for use in inductive reasoning. Also, Laughlin did not compare group performance to individual performance on his induction task, which the present research will do. Laughlin makes a distinction between the influence spontaneously occurring in groups, as in his study, and that occurring when a subject responds to a confederate or other influence source, as in prior studies. This distinction is of critical importance in the present study.

The present research will examine two often confused forms of social influence on the process by which facts are validated. The first is the social influence characteristic of the unidirectional influence of a source on a target, as in a persuasive communication. The second is the interactive influence characteristic of spontaneous group discussion. The present research holds that the

formation of consensus in a group discussion may result in more veridical perceptions than unilateral social influence.

Consensus in Group Problem Solving

Psychology has been committed to the theoretical position that consensus is secondary to empirical criteria in the definition of facts and norms concerning social reality. Festinger's (1954) social comparison theory posited that consensus serves as the criterion of truth only in situations which lack distinctive empirical criteria. This position is consistent with Sherif's (1936) work which demonstrated that consensus defined norms for the perception of an ambiguous physical stimulus (i.e., the autokinetic effect).

However, consensus may sometimes be a primary criterion for validating propositions about empirical reality even when evidence is distinct. Asch (1956) demonstrated that a distinctive empirical stimulus is perceived to conform to a consensus, even if that consensus maintains an erroneous perception of the stimulus. Nevertheless, attribution theory has held that consensus information is used to make attributions about events only when stimuli related to events either are indistinctive or are inconsistent over time and modality (Kelley, 1967). In attribution theory, a false consensus is an individual's erroneous inference that

others share his/her beliefs. This self-based consensus is not warranted by objective evidence and is considered an "attributional error".

In their presentation of their model of group problem solving, Kelley and Thibout (1969, p. 57) review models of responses in group discussion in which no consensus is imposed. In the independence model, the group outcome is identical to the outcomes of its individual members. In the rational model, all members adopt the correct solution once one member persuasively communicates it to others. Kelley and Thibout proposed a consensus model which was necessary to account for the fact that solutions produced in group discussions often did not conform to either the rational or independence model. In their consensus model, pressures toward uniformity spontaneously arise in group discussion to produce a solution which is (a) independent of that of the individual members and (b) not the most accurate solution offered by an individual group member. They further report on the normative model in which responses conform to social norms made salient in discussion. However, they limit the normative model strictly to problems linked to social norms and values where no objective criteria for a solution exist.

For Kelley and Thibout, the conformity pressures in group discussion bias objective problem solving by groups.

In general, they consider group problem solving which is above, below and at the level of the most proficient individual. However, they do not consider the possibility of problem solving by groups which is more proficient than that of an individual member or members. Instead, they characterize group problem solving as "slow", "uncoordinated", and "risky". Thus, consensus which spontaneously occurs in group discussion is viewed as irrational. Further, studies in which consensus is manipulated (cf. Asch, 1956) may be mistakenly used to support the view of consensus as irrational, as will be discussed further.

According to Kelly and Thibout's (1969) model, group problem solving requires an attributional "search for meaning" which can be functionally autonomous of problem solving. This state of information dependence involves the active seeking and acceptance of information from others. Such a "curiosity drive" which seeks knowledge for its own sake is based on Heider's (1958) model in which subjects refer transient events to more stable underlying forces. This model may be further supported by Berlyne's (1966) work on epistemic curiosity which, as will be discussed later, may also motivate the perceptual inferences necessary to verify evidence.

Kelley and Thibout state several criteria which

individuals use to make attributions about objective events or subjective states (e.g., feelings, perceptions).

1. Distinctiveness. An event or state is attributed to an entity because the event occurs when the entity is present but not when it is absent.

2. Consistency over time. An event or state is attributed to an entity because the event occurs every time the entity is present.

3. Consistency over modality. An event or state is attributed to an entity because the event occurs regardless of the mode by which the entity interacts with the event or state.

4. Consensus. An event or state is attributed to an entity because the entity consistently produces the same state in others or because others agree that the entity causes an event to occur.

Kelley and Thibout note that these criteria do not necessarily establish a veridical attribution, but do establish the subjective perception or feeling that the attribution is valid (i.e., veridical). Therefore, these criteria are used to render the world attributionally stable so that the individual can predict and control the events in his/her life.

Kelley and Thibout especially apply the model of information dependence to groups whose motives are both

cooperative and competitive. The theory of information dependence essentially states that person B is dependent on person A if person A can induce in person B a high level of attributional stability. Thus, person A can exert behavior control over person B because of the information dependence that person B has upon person A. In behavior control, person A's behavior will influence the behavior of person B by providing incentives or disincentives. Given convergent interests of the group, social influence will be based on information dependence and expressed in behavior control. However, given divergent interests of group members, social influence will be based on outcome dependence and will be expressed in fate control. In fate control, person A influences the behavior of person B but person B cannot influence person A, as he/she can in behavior control.

Kelley and Thibout state that person B may be continuously dependent on person A if the information conveyed by person A prevents person B from establishing attributional stability for himself/herself. Kelley and Thibout state that messages which present opposing views or alternative possibilities provide inconsistent information which inhibits stable attributions. Person B will continue to be dependent on person A if the former continues to believe both that person A can provide him/her with attributional stability and that attributional stability is

possible. Otherwise, person B will abandon the search for attributional stability.

Kelley and Thibout state that attributional instability in a person leads to his/her susceptibility to influence. Such attributional instability is characteristic of a lack of social support, ambiguous information, low self-confidence, difficult problems, and inappropriate solutions. The ability of an agent to influence those with high attributional instability is based on that agent's strength and confidence, information content, apparent consensual standing, and demonstrated efficacy.

The participants in a group may posses conflicting information (e.g., dissonant perceptions) or complementary information. Conflicting information produces a greater need for attributional stability. In the cooperative group where a task requiring the creation of attributional stability is conjunctive, the success of the task depends on the participation of each member. Conflicting information will either (a) produce more stable attributions due to the group pressure for uniformity of opinion or (b) overwhelm the capacity of the group to establish attributional stability.

Social Influence

Social psychological research has often used empirical stimuli to demonstrate conformity to norms (cf. Sherif,

1936; Asch, 1956). This research suggests that people conform to social norms to establish factual perceptions. This suggestion of the process by which empirical reality is socially constructed may be misleading. In most studies of social influence on empirical perception, conformity to the perceptions of others is a result of the unilateral influence exerted by one person or persons upon another person or persons. Such unilateral influence does not account for the interactive influence which occur in actual group processes. Unilateral social influence, such as that exerted by a persuasive communication, is often introduced into such group contexts where further influence occurs. The role of social influence in perception has not been adequately examined as a process of intersubjective consensus formation in groups.

Nail's (1986) comprehensive model describes the types of responses resulting from the social influence exerted by a source of influence on a target of influence. According to Nail, a single influence occasion consists of a sequence of three basic components:

1. The position of the influence target prior to exposure to the influence source.

2. The position of the model or influence source to which the target is exposed.

3. The position of the target after exposure to the

source's position.

These three basic components are common to the various forms of social influence which result from either the initial agreement or the initial disagreement of the source and the target.

Nail includes in his synthetic model an integration of descriptive and explanatory models first proposed by Allen (1965). Nail explains the influence responses proposed in his model based on the differentiation of normative and informational influence. Normative influence is produced when a target is exposed to a position which contradicts a position which he/she regards as obvious or to which he/she is strongly committed. The result of normative influence is public compliance and private disagreement with the group (i.e., "compliance"). For example, Asch (1956) created normative influence on subjects exposed to the obviously erroneous position of a unanimous consensus of confederates. In his experiments, subjects conformed to the erroneous perception of the equality of the length of two lines, unless at least one of the confederates expressed dissent with the majority.

Informational influence is produced when a target is exposed to a position which is ambiguous and to which he/she is not strongly committed. The result is public conformity and private agreement with the group, or

"conversion" in Nail's terminology. According to the formulation presented by Nail, Sherif (1936) produced informational influence resulting in conformity to an ambiguous empirical stimulus. Sherif demonstrated that consensus, in turn, creates standards for the perception of an ambiguous physical stimulus (i.e., the autokinetic effect). Subjects who formed individual perceptions of the stimulus subsequently altered their perceptions to conform to group standards. Subjects who formed their perception in conformity to a group standard subsequently retained the group standard in their individual perceptions. However, Sherif was not able to establish whether individuals or groups made more accurate perceptions after they restructured their perceptions. The autokinetic effect lacks an external criterion of accuracy against which to compare subject's perceptions.

The conformity of subjects in Sherif's experiment was produced by their exposure to each others' positions. However, subjects did not extensively interact with each other to form a consensus on a perceptual norm. Thus, their judgments may have been more influenced by exposure to the information presented in each others' judgments than by social influence, such as conformity to norms by group pressure. The social factors entering into the formation of the subjects' standards remained largely unexplicated.

Did subjects in Sherif's experiment respond to the positions of the sources of influence independent of the sources themselves? As Nail suggests, influence by the position of the source is informational whereas influence by the source of the position is normative. That is, a person's opinion or perception may produce informational influence while the person presenting an opinion or perception may produce normative influence.

The confounding of interactive and unilateral social influence in psychological research is compounded by the use of simulated social influence. The studies of social influence on which Nail has based his model have manipulated influence upon a subject by establishing an initial position based on a) a confederate or confederates, and/or b) a preestablished consensual standard of which the subject is informed. For example, Allen and Wilder (1980) found that individuals "cognitively restructured" their conception of statements to conform to a consensus of which they were informed. Statements of common expressions (e.g., "to go out of my way") were interpreted by subjects in unconventional ways if the subjects were informed that a prior group of individuals had unanimously agreed on that unconventional interpretation. However, if subjects were informed that one member of the prior group disagreed with the group's interpretation, then subjects interpreted the

statements in conventional terms to an extent equal to other subjects who were not given such information.

Allen and Wilder believe that their results explain Asch's (1956) findings that subjects conform to erroneous consensual perceptions. Allen and Wilder attribute such conformity to the cognitive restructuring by subjects of their perceptions to conform to a unanimous consensus. However, conformity to an opinion about social reality, such as the idioms used by Allen and Wilder, may not reflect conformity to the perception of an ambiguous physical stimulus. Further, conformity based on indirect information about an anonymous consensus may not reflect conformity to a consensus which is formed as a result of actual group discussion. The original Asch paradigm was also devoid of any social interaction, employing confederates who were directly observed by subjects as a unilateral source of influence.

The primary focus of most studies involving social influence and perception is the process of conformity rather than the perceptual processes occuring during conformity. The present research aims to give more consideration to the perceptual processes occurring during social influence. Of particular interest here are the perceptual processes by which facts are socially constructed.

Perceptual Inference

Increased attention to a stimulus may be expected whenever a stimulus produces a perception which is incongruous with prior expectations. A novel stimulus is known to attract a greater focus of attention than a mundane stimulus (Berlyne, 1966, Broadbent, 1958, Koffka, 1935). Perceptions which are incongruous with expectations arouse epistemic curiosity which triggers exploration in both animals and humans (Berlyne, 1966). According to Berlyne, perceptual curiosity is a motivational state of discomfort aroused by conflicting and uncertain stimuli which drives exploratory behavior. The effects of stimuli which are novel, surprising, incongruous, or variable depend on conflict in reactions to the stimuli. Therefore, epistemic curiosity involves "conceptual conflict" which is not limited to stimulus properties. Further, epistemic curiosity may involve knowledge of both immediate and long term interest.

In a computer simulation of social influence, Campbell, Tesser, and Fairey (1986) studied the conformity of individuals' judgments of an incongruous stimulus across influence occasions. Overall, they found that attention to a stimulus incongruous with normative expectations had no effect on conformity and that conformity had no effect on attention to the incongruous stimulus. However, they found

that attention to an incongruous stimulus is increased with conformity to extreme norms but only on later influence occasions. In contrast, attention to a stimulus was decreased with conformity to moderate norms on later influence occasions. Social pressure created by a computer may produce the same results as true social pressure to conform to erroneous perceptual judgments. However, the reasons for such conformity may differ between human and computer sources of influence.

The results of the study by Campbell et al leave open the question of why attention to an incongruous stimulus is associated with both normative and informational influence. As Campbell et al note, attention to a stimulus has been found to increase when others have made a clearly incorrect judgment of the stimulus as well as when others have made an apparently correct judgment. In the former case, according to Campbell et al, the exertion of normative influence is associated with increased attention reflecting an ambivalence about rejecting others' judgments. In the latter case, according to Campbell et al, informational influence associated with increased attention reflects a validation process marked by an ambivalence about accepting others' judgments.

The curiosity aroused by incongruous perceptions may trigger perceptual inferences which verify the factual

status of the incongruous stimulus. The evidential process by which a perception is verified as factual requires these implicit perceptual inferences. These implicit inferences may either bring perceptions in conformity with factual preconceptions or change preconceptions in conformity with perceptions. Such perceptual inferences are distinct from and prior to the logical inference processes, such as induction and deduction, which have been previously examined (cf. Schum & Martin, 1982, Mynatt, et al., 1978). Further, social pressure influences responses on perceptual tasks (e.g., Asch-type situations) more than responses on logical tasks (Liberman & Meyerhoff, 1986).

Bush (1982) has reformulated the traditional empiricist view of perceptual inference in light of (a) critique by phenomenological theorists, such as Austin, and (b) developments in cybernetic information theory. The traditional empirical view expounded by Locke, Berkeley, and others stated that a mentalistic process of inference intervened between sensations and perceptions. For example, Bush notes that Firth described the mentalistic processes of perceptual inference as a "discursive inference" quickly and habitually performed by a person in the process of constructing a percept from elementary empirical stimuli. Theorists such as Austin and the Gestalt psychologists rejected such processes of perceptual

inference because they were not not phenomenally (i.e., consciously) experienced by the perceiver.

Bush states that the phenomenalist's rejection of perceptual inference has merit. According to Bush, the empiricist performs a rational reconstruction of perceptual inference. The empiricist then mistakenly equates this reconstruction with the phenomenal process of perceptual inference. However, Bush also contends that the phenomenological rejection of perceptual inference does not adequately account for perception. A percept is based on more information than is immediately given in the stimulus object and the sensation it produces. Thus, perceptual knowledge cannot be rationally justified without proposing either a rational or psychological process of inference. This process of perceptual inference permits a perception to involve more information than is immediately given in a sensation.

Bush proposes that the existence of perceptual inference is warranted because of the neural integration of information which intervenes between sensation and perception. Bush further proposes that this physiological basis of perceptual inference can be cybernetically modeled based on psychological experimentation as an information processing system. As Bush notes, such a basis for perceptual inference is anathema in philosophical

epistemology but is a commonplace assumption in psychology. The epistemological process of perceptual inference used to justify a fact is investigated here as a social psychological phenomenon. The construction of a model of perceptual inference processes is beyond the scope of this research.

Perceptual inferences are specifically directed toward evidential verification in response to ambiguous stimuli (e.g., perceptual illusions). The reduction of perceptual illusions (e.g., the Muller-Lyer illusion) due to interaction with the illusory stimulus is a function of both structural physiological factors and cognitive reorganization (Girgus, Coren, Durant, & Porac, 1975). Girgus et al found that approximately 35% of the illusion created by the Brentano form of the Muller-Lyer illusion can be attributed to information processing mechanisms performed in successive interactions with the Muller-Lyer stimulus for 10 minute sessions on five consecutive days. Thus, the individual's repeated and direct interaction with an ambiguous stimulus would be expected to result in a more accurate perception of the stimulus.

Evidential reasoning about an incongruous and ambiguous stimulus (e.g., the Muller-Lyer stimulus) during interaction with it may also be influenced by factors external to the stimulus. The magnitude of the Muller-Lyer

illusion has been found to vary with a number of such factors, including age (Frederickson & Guerin, 1973), cognitive style (Jarman, 1979), cognitive development (Girgus, Coren, & Fraenkel, 1975), psychopathology (Spaulding, 1978), verbal intelligence (Eisner and Apfeldorf, 1971), acculturation in a noncarpentered environment (Pederson & Wheeler, 1983), field dependence and prior knowledge of the illusion (DiNuovo, 1984), and pigmentation of the fundus oculi (Pollack & Silvar, 1967). The research here addresses the effects of both external social influence and group processes on the perceptual inferences used to validate an incongruous and ambiguous stimulus through direct and repeated interaction with that stimulus.

Hypotheses

Subjects will respond to contradictory information about an apparently obvious perception created by an ambiguous stimulus by altering their perception of the stimulus. Subjects will make more change in their perception resulting in less perceptual error to the extent which:

1. The initial disposition of the stimulus was directly established by them rather than established for them by others.

2. The change is made collectively through group

discussion rather than individually.

3. The change is produced by group discussion without external influence rather than by individuals exposed to external influence.

Subjects altering a stimulus which they themselves have established will make more change and less error in perception than subjects exposed to a stimulus established by others. These others will constitute an external source of influence upon the subjects' perceptual judgments. These others will be either an observed confederate or others not present in the experiment (i.e., a remote consensus). Further, subjects acting as groups will make more veridical perceptual alterations than subjects acting individually. Thus, evidential perceptual inference about an ambiguous perception will be more veridical as a result of social interaction (i.e., group discussion) but not unilateral social influence exerted on individuals. The evidential process will be most veridical when it is performed by groups in the absence of external influence and least veridical when it is performed by individuals exposed to external influence.

The Muller-Lyer illusion will be used to operationalize a perception which only apparently corresponds to a fact. The Muller-Lyer stimulus produces an erroneous perception in which two lines which are in fact equal in length appear

unequal in length. Thus, the equality of the two lines appears obvious but is in fact erroneous. The Muller-Lyer illusion is unlike ambiguous stimuli used in previous studies of social influence (e.g., the autokinetic effect) because it provides an objective criterion for measuring the accuracy of subjective perceptions. Further, the Muller-Lyer stimulus permits direct interaction between the subjects and stimulus. Thus, changes in perception may be indicated by physical changes in the stimulus. These changes in the stimulus will produce different perceptions. Thus, subjects are interacting with the stimulus rather than either passively responding to it or actively manipulating it.

Veridical information given to subjects regarding the Muller-Lyer stimulus will contradict the subjects' initial perceptions due to the illusory nature of the stimulus. In response to this incongruous information, groups of subjects will make greater and more accurate changes in the Muller-Lyer stimulus than individual subjects. Group discussion will amplify the individual tendency to make increasingly veridical perceptions of the Muller-Lyer stimulus with increased interaction with it. Subjects who have initially established a perceptual fact (i.e., the equality of the two lines) will make greater and more accurate changes in the Muller-Lyer stimulus than those who

have not. In contrast, those who respond to an empirical fact established by others will make less accurate changes in the Muller-Lyer stimulus than those who have established the fact for themselves. Thus, perception of the stimulus will be erroneously influenced by exposure to the perceptions established either by a presumed consensus or by an observed model.

Preliminary Experiment

Method

Subjects

The subjects were 89 undergraduate college students registered in Statistics and Experimental Psychology courses who participated in the experiment as an instructional exercise. Of these 89 subjects, 69 were randomly formed into 23 groups each of which had three members. The remaining 20 subjects acted as individuals in the experiment.

Stimulus Materials

The stimulus was a display of the Muller-Lyer illusion manufactured by Lafeyette Instruments to demonstrate the illusion. The display is a black wooden board two feet long and one foot high. This display depicted the Brentano form of the illusion in which the two lines are continuous rather than parallel with each other. The comparison line has "fins" or "feathers" on each end and the standard line

has "arrows" on each end. The center marking acts as both a fin of the comparison line and an arrow of the standard line, as such: <---->---->.

The display permits the physical adjustment of the length of the comparison line in relation to the standard line. The display has a ruler on its reverse side which permits measurement on a ordinal scale in centimeters of the degree to which the comparison line deviates from being equal to the standard line. The zero point on the scale indicates that the standard and comparison lines are truly equal to each other. Negative deviations from this zero point indicate the degree to which the comparison line is shorter than the standard line. Positive deviations indicate the extent to which the comparison line exceeds the standard line. The illusion causes subjects to perceive the comparison line to be longer than the standard line. The subjects must judge the stimulus from a distance of 10 feet from the display.

The experimenter can measure the accuracy of the perception produced by the subjects' manipulation of the comparison line. The subjects cannot know the accuracy of their adjustments because the ruler is on the reverse side of the display. Thus, information given to the subjects by the experimenter about the relative lengths of the two lines in the display cannot be anticipated by the subjects.

Procedure

The subjects were first randomly assigned to six experimental conditions using a random numbers table. Of the total number of subjects, 69 subjects were randomly constituted into 23 groups with three members each. These 23 groups were randomly assigned to three of the six experimental conditions. The remaining 20 subjects were each randomly assigned to one of the three remaining experimental conditions. They acted as individuals in each of these three conditions.

Subjects were given informed consent forms and told only that the experiment involved a test of perceptual judgment. No other information was given to the subjects about the experiment. A volunteer drawn from the subject pool was requested to act as an assistant of the experimenter. This volunteer was to perform as a confederate in two of the six experimental conditions. A number of different confederates were used across the groups assigned to conditions requiring confederates. The subjects were then asked to wait in an adjacent lounge area.

The subjects were called into the laboratory either individually or in groups of three according to their random assignments. The subjects were seated 10 feet from the stimulus. The experiment began by presenting the

Muller-Lyer stimulus to subjects and asking them if they had ever seen the display or the lines depicted on it. Subjects who recognized the Muller-Lyer display to any extent were kept in the experiment. Their prior knowledge was noted and used as a variable for control purposes.

In each of the conditions, the stimulus display was first explained to the subjects. Subjects were informed that the line with arrows on each end was a standard line which was stationary, that the line with feathers was a comparison line which was adjustable by moving it back and forth. The subjects were prevented from touching the display in any other way, such as by using their fingers to measure the lines.

Social influence.

The degree of social influence was manipulated by varying the initial position of the stimulus and the illusion magnitude which this produced. All subjects were required to readjust the initially established stimulus. In the Remote Consensus condition, subjects were required to readjust the stimulus which had been preset by the experimenter to a position which was the average initial setting of subjects in pilot studies. In the Observed Model condition, subjects were required to readjust the stimulus established by a confederate whom they observed establishing the stimulus. In a Control condition,

subjects were required both to initially adjust and to readjust the stimulus. The subjects were assigned to one of these three conditions, and acted either individually or in a group of three members.

The manipulation of the social influence variable was designed to create three levels of social influence reflecting the varying degrees of immediacy with which the subjects experienced the initial illusion. The experience of the initial illusion was more direct for subjects who established it themselves than for subjects who observed a model establish it vicariously for them. Similarly, this vicarious experience of the illusion was more direct than being informed that the preestablished illusion reflected a consensus of remote others.

Control condition.

After being introduced to the stimulus display, individual subjects were given the following instructions:

> Please adjust the comparison line so that it is equal in length to the standard line. Please make all your adjustments from the seat directly in front of the display. Make your judgments from the seat at a distance from the display. Make as many adjustments as you feel necessary.

The subjects in groups were given the following instructions after being introduced to the display:

Please adjust the comparison line so that it is equal in length to the standard line. Please take turns making your adjustments and stop making your adjustments when you all agree that the two lines are equal, or as equal as you can make them. Take as many turns as you feel necessary. Please make all your adjustments from the seat directly in front of the display. Make your judgments from the seat at a distance from the display. Please feel free to discuss your adjustments and agreement.

In each of the conditions, the subjects made their judgments and decisions from a distance of 10 feet from the display. After completing their adjustments, the subjects were asked if the two lines appeared equal in length. Their responses were noted and the illusion magnitude of the stimulus was recorded. As expected, none of the subjects in any of the conditions made accurate initial adjustments of the stimulus display due to the strength of the Muller-Lyer illusion.

After the illusion magnitude of the initial setting was recorded, the subjects were informed that "in fact, the comparison line and the standard line are not equal in length." Both individuals and groups were then instructed to readjust the comparison line so that it is more equal in length to the standard line. The subjects acting in groups

and as individuals were instructed to follow the same procedure as in their respective initial adjustments. The respective procedures for readjustment followed by groups and individuals were identical in all social influence conditions. The final readjustments made by each of the groups and individuals were recorded. The subjects were then debriefed.

Observed Model condition.

After being introduced to the display, both individuals and groups in this condition were instructed to observe a confederate adjust the comparison line to where she perceived it to be equal in length to the standard line. The confederate was given the same instructions described for the individual subjects in the control condition.

The subjects acting either as groups or as individuals were then asked if the two lines appeared equal in length. The subjects' responses were recorded and they were informed that the two lines were not equal in length. The subjects were then instructed to readjust the comparison line so that it appeared more equal in length than where the confederate had adjusted it. The subjects did so in the absence of the confederate. The final readjustments made by each of the groups and individuals were recorded. The subjects were then debriefed.

Remote Consensus condition.

In this condition, the subjects were presented with the Muller-Lyer stimulus preadjusted such that the comparison line exceeded the standard line by 3.6 centimeters. This setting of 3.6 cm. was found in trials performed with six subjects not included in the experiment. At this setting the lines appeared equal in length to most subjects. The subjects were informed that the lines had been preset to the position where others had on an average believed the two lines to be equal in length. Thus, influence was manipulated as in previous studies (cf. Allen and Wilder, 1980) in which subjects are informed of a fictional consensus without direct exposure to others. The subjects were then asked if the two lines appeared equal in length. The subjects' answers were recorded and they were informed that the two lines were not in fact equal in length. The subjects were then given the same instructions used in all conditions for readjusting the comparison line. The final readjustments made by each of the groups and individuals were recorded. The subjects were then debriefed.

Facilitation and control.

The experimenter was present in all experimental conditions to ensure control. For example, the experimenter prevented the subjects from measuring the stimulus with their hands. In the conditions with three member groups, the experimenter acted to facilitate

consensus without acting either as a member of the group or as a group leader. Across group conditions, the experimenter prevented the closure which is characteristic of groups following a rational model by using standard statements. Much of this facilitation involved restating the instructions to the subjects, or to particular subjects, in the course of the group. For example, subjects reluctant to make adjustments were encouraged to contribute to the group if they felt they could improve on the group solution.

De-briefing.

The subjects were shown the ruler on the reverse side of the display, and given the degree of difference in their pre and post adjustments. The subjects were also shown the lines adjusted at the point of true equality to each other to demonstrate the illusion. The Muller-Lyer illusion and the hypotheses of the experiment were explained to the subjects. The subjects were informed that their inability to adjust the comparison line exactly equal to the standard line does not reflect on their intelligence or on any other cognitive ability, but instead represents an adaptive perceptual tendency.

The Dependent Variables: Change and Illusion Magnitude

The method of adjustment (average error) was used to measure the magnitude of the Muller-Lyer illusion.

Compared to the method of limits and the method of constant stimuli, McKelvie (1984) contends that the method of adjustment is the best method of measuring perceptual illusions. Further, he found this method to be the best for measuring the magnitude of the Muller-Lyer illusion. In the method of adjustment, the subject uses a small number of trials to adjust the comparison stimulus to equality with a standard. The method of adjustment provides the most precise estimate of the point of subjective equality, especially when the subject is permitted to freely adjust the comparison stimulus back and forth around this point.

The experiment involved two dependent variables: (a) the magnitude of the illusion produced by readjustment to the initial Muller-Lyer stimulus and (b) the degree to which subjects readjusted the initial stimulus. The magnitude of the illusion produced by the restructured stimulus was measured by the degree (in centimeters) to which the comparison line exceeded the standard in length after the subjects had made their readjustment. The illusion magnitude of the Muller-Lyer stimulus is increased to the extent which the comparison line exceeds the standard line. The relatively greater length of the comparison line produces the illusion that the two lines are equal in length. The stimulus is closer to true

equality to the extent which no difference between the standard and comparison line exists. However, true equality gives the appearance of inequality. The comparison line may also be adjusted such that it is shorter than the standard line. However, this would suggest that the subject adjusting the line is compensating for the illusion produced by the stimulus.

The degree to which subjects altered their perception of the stimulus was measured by the degree of change they made in the stimulus by their readjustments. Thus, a difference score was computed between the the initial length of the comparison line and the readjusted length of the comparison line. The degree of perceptual restructuring is thereby indicated by the amount of change in the initial illusion resulting from the readjustment of the Muller-Lyer stimulus. A positive difference between the initial illusion and the readjusted illusion indicates that subjects changed their perception in the direction of a more veridical but more illusory perception. A negative difference between the initial illusion and the readjusted illusion indicates that subjects changed their perception in the direction of a less veridical and more illusory perception.

The measures of both the perceptual change and the illusion magnitude of the three member groups is

represented by their intersubjective combination of their individual manipulations of the stimulus using the method of adjustment. Thus, a single score for change and a single score for illusion magnitude is yielded for each three member group. The individual scores on the two dependent variables made by each subject in each group were not separately recorded.

Design and Analysis

An Influence X Group Discussion X Prior Knowledge (3 X 2 X 2) factorial design was used for each of the two dependent variables: stimulus change and illusion magnitude. The initial illusion magnitude was a covariate of each dependent variable. An Analysis of Covariance (ANCOVA) was used to test the effects of group discussion, social influence and prior knowledge on the two dependent variables. The ANCOVA adjusted the analysis for the illusion magnitude created by the initial adjustment of the stimulus. Thus, the effects of the independent variables could be assessed independent of any confounding caused by the illusion magnitude of the initial stimulus which the subjects were required to change. The social influence exerted by a source on a target may have been particularly susceptible to confounding with the source's position. Therefore, normative influence created by the influence sources (i.e., the observed model and remote consensus) on

the subjects' perceptions was tested separately from informational influence on the subjects' perception. This informational influence was created by the sources' position, that is, the illusion magnitude created by the initially established position of the stimulus.

Preliminary Results and Discussion

The initial illusion magnitude significantly covaried with its change (F=9.36, df=1,30, p<.005) and with the illusion resulting from its change (F=11.38, df= 1,30, p<.001). In the ANCOVAs of both change and illusion, a marginally significant interaction was found between the initial stimulus establishment and the group discussion. An ANOVA without controlling for the initial illusion magnitude was used to test the effects of group discussion and stimulus establishment on both change and readjusted illusion. A significant interaction effect between group discussion and stimulus establishment on readjusted illusion was found (F=3.43, df=2,31, p<.05). Thus, a significantly less accurate perception was found in groups exposed to a confederate and in individuals exposed to a remote consensus than in the other conditions. However, this effect was produced only when the initial illusion magnitude was included in the covariance design.

Therefore, the above average illusion in these conditions was a function of the contribution of the

initial illusion magnitude in addition to the effects of the source (i.e., the influence agent) who established that illusion. The effects of the position of the source (i.e., the initially established illusion) are not independent of the effects of the source itself (i.e., the observed confederate or remote consensus). Informational influence by the position to which subjects were exposed (i.e., initial illusion) was confounded with any normative influence exerted by the source of that position.

The results were difficult to interpret in terms of the hypotheses. Individuals exposed to a confederate made the most change in the initial stimulus. This change was in the direction of veridicality and, as expected, resulted in relatively low levels of illusion. Groups exposed to a confederate also made relatively great changes in a veridical direction. However, these changes resulted in the greatest illusion of all the conditions. Also, individuals exposed to remote consensus made changes in the direction of illusion which produced a perception approximately as erroneous as that produced by the subjects in groups exposed to a confederate.

These results suggest that the initial illusion magnitude was confounded with the source of that illusion. However, this confounding was due to experimental artifact rather than an inextricable connection between the source

and position of an influence agent. The initial position of the stimulus established by the confederates was found to produce an illusion of extreme magnitude; 5.3 centimeters for groups and 4.5 centimeters for individuals. Thus, the subjects exposed to a confederate, especially those in groups, were influenced by an illusion of much greater magnitude than the subjects in the other conditions.

The extreme magnitude of these initial illusions may have influenced subjects to make readjustments of greater magnitude than those made by subjects in other conditions. Individuals exposed to confederates made readjustments which resulted in average error whereas groups exposed to confederates made readjustments which resulted in above average error. This confounding of the source and the position of the initial stimulus necessitated repeating the experiment by holding the initial illusion magnitude constant across all conditions.

Also, across all conditions in the preliminary experiment, subjects with prior knowledge of the illusion made less change in the initial stimulus and more error in the readjusted stimulus than those without prior knowledge. This finding contradicts prior research in which informing the subjects about the nature of the illusion reduced their subsequent perception of the

illusion (DiNuovo, 1984). Further, individuals exposed to a remote consensus made above average error which was greater than that of groups also exposed to a remote consensus. However, both conditions were predominantly composed of subjects with prior knowledge of the stimulus. Therefore, prior knowledge was confounded with social influence and group processes in the preliminary experiment. Subjects with prior knowledge of the stimulus were screened out of the final experiment.

Final Experiment

Method

Subjects

The subjects were 92 undergraduate college students most of whom were registered in two Introductory Psychology courses and participated in the experiment as an instructional exercise. Eight of these subjects were recruited from an Introductory Sociology course. None of these 92 subjects had prior knowledge of the stimulus. Of these 92 subjects, 54 were randomly formed into 18 groups each of which had three members. The other 38 subjects acted as individuals in the experiment. Subjects from the sociology course all acted as individuals.

Stimulus Materials and Procedure

The same stimulus was used as in the preliminary experiment. The procedure was also the same with certain

modifications. As in the preliminary experiment, the present experiment began by presenting the Muller-Lyer stimulus to subjects and asking them if they had ever seen the display or the lines depicted in it. Subjects who recognized the Muller-Lyer illusion to any extent were dismissed and the next subject in the random sequence was employed. Approximately eight subjects with prior information about the display were dismissed from the experiment. Three of these subjects had been assigned to one condition (the Remote Consensus), the others were approximately evenly distributed across the other conditions.

The control condition was administered first in order to establish a subjective norm for the initial perception of the equality of the two lines. This setting was to be used to establish the initial illusion magnitude in the experimental conditions. For groups and individuals combined, the mean deviation of the comparison line from the standard line at the initial adjustment was found to be 3.6 centimeters. This setting was used to preestablish the initial illusion magnitude in the experimental conditions.

Two female confederates were used across the groups assigned to the Observed Model condition. As in the preliminary experiment, the confederate in the Observed Model condition was given the same instructions described

for the individual subjects in the Control condition. However, unknown to the subjects, the confederate had been preinstructed to adjust the two lines to correspond to slight chalk marks made on the display. At this contrived setting, the comparison line exceeded the standard line by 3.6 centimeters. The subjects made their readjustments in the presence of the confederate who observed but did not participate in the readjustments of the stimulus by the subjects.

In the Remote Consensus condition, the subjects were presented with the Muller-Lyer stimulus preadjusted such that the comparison line exceeded the standard line by 3.6 centimeters, the amount established by the subjects in the control group in their initial settings. Thus, each of the subjects in the two experimental social influence conditions readjusted an illusion of approximately the same magnitude. In the Control condition, this initial illusion magnitude was on an average equal to that in the experimental conditions.

De-briefing.

The subjects in the modeling condition were asked if they noticed the confederate use any marks on the board to make her adjustment or if they themselves had used any markings to make their adjustments. None of the subjects in the Observed Model or other conditions noted the chalk

marks which the confederate used to make her adjustments. All subjects were asked if they knew of any reason why the lines may have appeared equal in length even though they were not in fact equal in length. Most of the subjects responded that the arrows biased their estimates of the equality of the lines. However, subjects did not convey this information to others during group discussion, with one exception. The data from one group of subjects in the modeling condition was eliminated because one of the subjects conveyed the meaning of the illusion to the other members of the group which caused the illusion to be dispelled.

This elimination was necessary to control for the Lorge effect in which the group adopts the correct solution proposed by one individual in a "Eureka" phenomenon. This group violated the consensus requirement of the condition because they were unilaterally influenced by an influence source within the group. This situation corresponds with Kelly and Thibout's rational model rather than with their consensus model of group problem solving. The debriefing otherwise proceeded as in the first experiment.

Design and Analysis

The dependent variables, stimulus change and illusion magnitude, were measured as in the first experiment. An Influence X Group Discussion (3 X 2) factorial design was

used for each of the dependent variables. As in the preliminary experiment, the initial illusion magnitude was a covariate of each dependent variable.

Results

The more direct was the experience of the subject in initially establishing the stimulus, the greater the change in the stimulus and less the illusion magnitude produced by this change in the stimulus. Direct stimulus establishment was negatively correlated with change in the initial stimulus (r= -.28, p<.01) and was positively correlated with the illusion magnitude produced by change (r=.23, p<.05). In other words, the stronger the external influence to which the subjects were exposed, the less change they made in the stimulus and the more accurate the perception resulting from this change.

An ANCOVA was used to test the effects of the independent variables on the change in the initially established illusion (see Table 1). An ANCOVA was also used to test the effects on the illusion produced by change in the initial illusion (see Table 2). The illusion magnitude created by the initial position of the stimulus significantly covaried with the illusion magnitude created by change in the initial position of the stimulus (F=10.24, df=1,49, p<.002). The illusion magnitude created by the initial position of the stimulus also significantly

covaried with the amount of change which subjects made to its initial position (F=11.15, df=1,49, p<.002).

Controlling for the initial illusion magnitude of the stimulus, groups were found to make significantly more veridical changes in the stimulus than individuals (F=4.32, df=1,49, p<.05). This change in the stimulus by groups resulted in significantly less illusion magnitude than that produced by individuals (F=4.32, df=1,49, p<.05). Thus, as expected, groups made more veridical changes in the stimulus and thereby produced more veridical perceptions than individuals.

Further, subjects made significantly more change in the stimulus when they themselves established the stimulus than when the stimulus was established for them either by remote others or by an observed model (F=5.04, df=2,49, p<.01). The change made by subjects to the stimulus when it was established by others was in the direction of greater illusion magnitude, or error. In contrast, the change made by subjects to the stimulus which they themselves had established was in the direction of less illusion, i.e., less error (see Table 3). Further, the illusion magnitude produced by subjects who changed the stimulus established by others was also significantly greater than that produced by subjects who changed the stimulus which they had established (F=5.04, df=2,49, p<.01).

Thus, subjects exposed to an external influence source (i.e., an observed model or a remote consensus) had less veridical perceptions than subjects not exposed to an external source (see Table 4). The subjects exposed to the external influence source altered the stimulus from its initial position to a position which created more illusion than the initial position. In contrast, the subjects not exposed to an influence source, that is, those who readjusted the stimulus which they had established, altered the stimulus from its initial position to a position which created less illuson than the original position. As will be discussed, this trend was not completely consistent with the expectations of the hypotheses.

Further ANOVA was performed to test the effects of group discussion and stimulus establishment on stimulus change (see Table 5) and illusion magnitude (see Table 6). These ANOVAs did not partial out the covariation of initial illusion magnitude with each of the dependent variables. Thus, the effects of the influence source were examined in combination with the source's position. This analysis produced most of the same main effects found using an ANCOVA with one exception. The difference between groups and individuals in the change made to the stimulus was only marginally significant ($F=3.33$, $df=1,50$, $p<.07$). Nevertheless, this marginally significant change by

individuals resulted in significantly greater illusion than that produced by groups (F=3.98, df=1,50, p<.05).

Therefore, the confounding of the initial illusion with the effects of group discussion and external social influence on perceptual change and accuracy was successfully controlled by holding the initial illusion constant in the experiment. The effects of the position of the influence source (i.e., the initial illusion) combined with the type of influence source (i.e., remote consensus or observed model) produced essentially the same results as the type of influence source independent of that source's position.

The greater veridicality of groups relative to individuals was not a function of the number of subjects manipulating the display. In the control conditions, an equal number of subjects were used in both the group and individual conditions (see Table 7). However, individuals in the control condition made less veridical perceptions than groups in the control condition. This trend was also found in the the experimental conditions in which the absolute number of subjects acting in groups exceeded the number of those acting as individuals.

Multiple Comparisons Between Conditions

Post hoc ranges tests were used to examine the pairwise differences between the means of each experimental

condition. For each of the two dependent variables, change and illusion magnitude, four separate ANOVAs with range tests were performed. Two analyses were performed for groups, two for individuals, two for groups and individuals combined, and two for the six independent conditions in relation to each other. Thus, in all, eight separate ANOVAs were performed. Each of these ANOVAs included four different range tests: the Newman Keuls Multiple Range Test, the Least Significant Difference (LSD) range test, the Scheffe range test, and Tukey honestly significant difference (hsd) range test.

Groups and individuals combined.

A Newman-Keuls Multiple Range Test and an LSD range test indicated that individuals and groups combined made significantly more veridical change in the illusion which they had established than in the illusion established both by an observed model and by remote consensus ($F=4.40$, $df=2,53$, $p<.01$). Tukey and Scheffe range tests indicated the subjects made significantly more veridical change in the stimulus they had established compared only to the stimulus which the confederate had established. As mentioned, the subjects exposed to the confederate and to the remote consensus made changes in the direction of greater error. The subjects not exposed to an influence source made changes in the direction of greater accuracy.

The illusion resulting from these changes was greater under the influence of an external source. However, these differences were not as strong as those found for change in the illusion. The ANOVA indicated only marginally significant differences between social influence conditions in the illusion magnitude created (F=2.72, df=2,53, p<.07). However, the LSD range test indicated that the illusion perceived by the subjects who had readjusted the perception established by the observed confederate was significantly greater than that perceived by subjects who readjusted the illusion which they themselves had established.

Individuals.

The Newman Keuls range test indicated that subjects acting individually made significantly more veridical change in the stimulus which they had established themselves compared to that established by others (F=6.83, df=2,35, p<.003). However, the Tukey and Scheffe range tests indicated significant differences in the change made by individuals in the illusion they had established compared only to the illusion established by an observed model. Newman-Keuls, Tukey, Scheffe, and LSD range tests all indicated that individuals who readjusted the illusion established by an observed model perceived significantly more illusion than individuals who readjusted the illusion

which they themselves had established (F=3.65, df=2,35, p<.04).

Groups.

No significant differences were found between subjects acting in the group conditions influenced by others versus those not influenced by others. Thus, individuals were more influenced by an external source whereas groups were not. Further, this influence produced less veridical perceptions in individuals but not in groups.

The Six Independent Conditions.

Range tests were also used to test the significance of the differences in stimulus change and illusion magnitude between each of the pairs of six conditions in the design. Thus, each of the six experimental conditions was treated as an independent comparison group. Tukey hsd and Newman-Keuls range tests indicated that individuals who readjusted the stimulus which they themselves had established made significantly greater change in the initial illusion than individuals who adjusted the illusion which they observed a confederate establish (F=3.12, df=5,50, p<.01). The changes made by the individuals readjusting the stimulus which they had positioned were in the direction of a more accurate perception. In contrast, the changes made by the individuals to the stimulus established by a confederate were in the direction of a

less accurate perception.

Further, the LSD range test indicated that individuals exposed to the model made changes in the stimulus toward a more erroneous perception which were significantly greater than the changes in the stimulus toward a less erroneous perception made by a) individuals not exposed to an influence source, b) groups exposed to a model, and c) groups not exposed to an influence source. Also, a Newman-Keuls range test indicated that individuals who readjusted the stimulus which they themselves had established produced significantly less illusion than individuals who adjusted the stimulus which they observed a confederate establish ($F=2.39$, $df=5,50$, $p<.01$).

Discussion

The results support two of the three hypotheses. First, groups instructed to reach consensus made more veridical perceptions than individuals. Second, subjects exposed to an external source of influence made less veridical perceptions than those not so exposed. The results only partially support the third hypothesis that groups without external influence will produce more veridical perceptions than individuals exposed to external influence. The absence of significant interactions does not support the third hypothesis.

However, consistent with the third hypothesis,

individuals influenced by a confederate made the least veridical perceptions whereas groups not influenced by an external source, that is, those in the control condition, made the most veridical perceptions. The LSD range test performed on the six experimental conditions as independent groups indicates that individuals exposed to an influence source made significantly more veridical changes in their perception than groups not exposed to influence. This range test also indicates that the individuals exposed to influence made significantly more veridical changes in their perception than groups exposed to influence and individuals not exposed to influence.

Overall, the external influence biasing veridical perceptions was greater for individuals than for groups. Individuals moved slightly toward error in their responses whereas groups moved toward veridicality despite the fact that both groups and individuals responded to the same average initial illusion magnitude as well as the same source of illusion. In each of the influence conditions, individuals were less veridical than groups both in their changes in perception and in their final perception. This was especially true in the condition in which the subjects were exposed to influence from a model who established the initial illusion magnitude.

The changes made by subjects in the experimental

conditions did not reflect the possibility that they performed fewer manipulations of the stimulus than subjects in the control conditions. Adjustments by subjects in the direction of error are counter to the tendency for individuals to make veridical changes in the Muller-Lyer stimulus (cf. Girgus, et al, 1975). Therefore, subjects making few adjustments to the stimulus should make less change in the stimulus in the direction of veridicality than subjects making many adjustments to the stimulus.

However, subjects in the influence conditions, who made quantitatively more adjustments to the stimulus, made greater change in the stimulus, but in the direction of error rather than accuracy. Thus, exposure to a source of influence reversed the normal tendency to increase in perceptual accuracy. This was counter to the expectation that those exposed to influence would make less change in the stimulus in the direction of accuracy than those not exposed to influence. Further, the net illusion magnitude created by readjustments is greater if the readjustments are in the direction of error rather than in the direction of accuracy.

Explanation of the results in terms of normative and informational influence is facilitated by the use of the ANCOVA. The contribution of the position established by the influence agent (i.e., informational influence) to the

subjects' responses was partialed out of the experiment by the ANCOVA. Thus, the effects of exposure to a remote consensus or the observed confederate (i.e., normative influence) were not confounded with the effect of the initial illusion magnitude (i.e., informational influence) established by the confederate or consensus. The greater error made by subjects exposed to an influence agent relative to those not so exposed was not confounded with their response to the position established by that influence agent. This suggests that normative influence rather than informational influence was exerted by the observed confederate and the remote consensus (i.e., the sources of influence). This normative influence biased the formation of a veridical perception by subjects.

Further, even when the informational influence of the source's position was included in the design, subjects exposed to an influence source made significantly less veridical perceptions than those not exposed. Thus, informational influence did not contribute much to an overall increase or decrease in the formation of a veridical perception. Instead, normative influence exerted by the source significantly biased the perceptions of the subjects acting as individuals. This is counter to the claim made by Campbell et al (1986) that informational influence occurs when subjects are ambivalent about

accepting the apparently correct positions of others.

An satisfactory explanation of the tendency for subjects to make perceptual error under the influence of others requires further investigation. Exposure to an influence agent may have produced psychological reactance (Brehm, 1966). The subjects' normal perceptual tendencies to increase in perceptual accuracy may have been subconsciously reversed because they felt that their freedom to readjust the stimulus was constrained by the fact that the stimulus was established for them by someone else. Such reactance may have been an attitudinal predisposition of the subjects, especially those in this particular sample, which could be included as a covariate in further replications.

The subjects in the sample were students at a large nonresidential urban university with an open admissions policy. The results most immediately suggest that such students must learn by direct involvement in a discovery process, especially when the material to be learned contradicts their everyday commonsense assumptions. Such students may react against knowledge presented in an axiomatic fashion. The result is that the students form idiosyncratic conceptions of the knowledge presented. These misconceptions may be a way of retaining an individual and subcultural identity which is threatened by

the axiomatic knowledge which contradicts their world view. For example, many students in statistics courses cannot accept the concept of random chance because it contradicts the overdetermination operating in their world view. Similarly, the concept of random variation in evolution militates against a religious world view in which God determines nature's variations.

Rationality of Consensus.

Contrary to the consensus model proposed by Kelly and Thibout (1969), consensus in group discussions produced a "rational" decision (i.e., a veridical perception). The experiment deliberately facilitated consensus and prevented the rational decisions characterized by the Lorge effect in which the group adopts the most correct individual solution. The experiment also prevented independent solutions by not using "nominal" groups which simply record the individual solutions of a collection of people. Kelly and Thibout base their view of consensus on conformity pressures which spontaneously arise in groups. However, the present results indicate that more veridical perceptions occur when consensus is required or facilitated than when it is not.

Thus, phenomenon such as "groupthink" (Janis, 1967) may not occur when consensus is facilitated in response to a situation where an apparently obvious fact has been

contradicted. Further investigation to establish the role of facilitation in the consensus process is necessary. Subjects may produce a veridical perception when consensus is required but not facilitated by an external source. Also, facilitation of consensus in further studies should be performed by a number of agents who are blind to the hypotheses and randomly assigned to conditions.

The results are consistent with the phenomenon of group polarization. In response to an ambiguous stimulus, a group would be expected to polarize the tendencies of its members toward that stimulus. Individuals have a tendency to make increasingly veridical perceptions of the Muller-Lyer stimulus with continued interaction with it. Therefore, group discussion by these individuals may have polarized this tendency. Group discussion also polarized the tendency for individuals to make changes toward greater error when exposed to influence agents. Myers and Lamm (1976) have reviewed the phenomenon of group polarization in which group discussion facilitates cognitive processes which lead individuals to amplify their individual opinions. The result of this polarization is a group opinion which is more extreme than the initial individual opinions of group members. For example, Rettig (1967) demonstrated that the perception of the value of an object obtained by unethical means was enhanced by group

discussion. This enhancement was produced by the polarization of the individual perceptions to which group members were predisposed.

The results of the present study may be more parsimoniously explained in terms of group facilitation rather than group polarization. Polarization requires group discussion whereas facilitation requires only the mere presence of others. Further investigations could manipulate the quantity of discussion used in the formation of consensus.

Social comparison theory and attribution theory hold that individuals use social interaction or consensus information to define ambiguous situations and entities only in the absence of objective information. Both theories presume that subjects prefer objective evidence to intersubjective evidence because the former provides more veridical (i.e., distinctive and consistent) information than the latter. The hypotheses of the present research were formulated based on the assumption that individuals would use social information in response to an ambiguous empirical stimulus. However, the results here indicate that consensus formation in social interaction produces veridical perceptions if it is not biased by external influence. This suggests that consensus can be a rational process by which empirical reality is defined. Further

research may investigate the conditions under which consensus information results in more or less veridical perceptions than objective information. However, such research should operationalize consensus as process occurring in actual group discussion rather than as an informational content which the subject passively receives.

Scientific Evidential Reasoning.

In sociological theory, Habermas (1981) has proposed that rational consensus formed through discourse is required to validate propositions about social and physical reality. Habermas further states that rational consensus is prevented by external influences, specifically demands imposed by action and ideology. According to Habermas, rational consensus in discourse is an essentially emancipatory process. Ideological and instrumental imperatives constrain the emancipatory quality of discourse and produce a false consensus. For example, ideological motives constrained the scientific discourse on genetics in the Lysenko affair. Similarly, instrumental motives may have distorted the scientific discourse on "cold fusion". The imperative to create a more efficient source of energy may have biased the empirical perceptions of the experimental evidence use to warrant fusion.

Kuhn (1970) proposed that psychological experiments in perception are suggestive of the process by which

scientists experience a shift in the paradigms with which they view empirical phenomena. For example, Kuhn proposes that the perceptual transformations produced by reversible figures (e.g, a Necker Cube) are analogous to the scientist's shift in his/her perception of empirical phenomena from the perspective of a "normal science" paradigm to that of a "revolutionary" paradigm. Kuhn notes that in science, unlike in perceptual experiments, no external standard exists by which an empirical observation may be validated.

The availability of such a standard permits the subject in the perceptual experiment to consciously reverse his/her perception of the stimulus. However, the unavailability of such authoritative criteria in science prevents the scientist from shifting his/her perception of empirical phenomena between competing paradigms. Thus, the post-Copernican scientist sees the moon only as a satellite, not interchangeably as a satellite or a planet. Similarly, the reversible scientific perception of light as either a wave or a particle produced a crisis resolved by the realization that light, as an objective entity, is independent of its perception by scientists as either a wave or a particle.

The present experiment is more closely analogous to the process of normal scientific discovery than experiments

which have used reversible stimuli, which are relatively more analogous to revolutionary scientific discovery. Unlike the stimuli in prior experiments, the Muller-Lyer stimulus does not create a reversible perception. More important, the Muller-Lyer stimulus has a definitive criterion against which subjective perceptions can be measured. Subjects can closely approach this criterion through their interaction with the stimulus. Therefore, perceptual transformations of the Muller-Lyer stimulus are unidirectional in their movement either to or from veridicality. These transformations are analogous to transformations in scientific evidential reasoning occurring within a normal science paradigm.

The process of scientific discovery involves perceptual transformations of empirical phenomenon which have a veridical existence. Although these phenomena are real and not illusory, their reality may be unknown or unknowable. A scientific perception of an object may never perfectly correspond to the veridical reality of that object, which is often of an ultimately metaphysical nature. Similarly, subjects may become more veridical in their perception of the Muller-Lyer stimulus up to a point beyond which veridical perception is not possible. However, the Muller-Lyer stimulus does not produce an illusion for which no correct perception is possible, as does the autokinetic

stimulus.

Thus, the results of the present study may be generalized to the context of scientific discovery where empirical phenomena are ambiguous. The results suggest that scientists operating collectively on the basis of consensus may make more veridical perceptions than scientists operating individually. Similarly, peer review in scientific disciplines, such as that which occurs in refereed journals, validates empirical evidence by consensus rather than by individual standards. However, the process of scientific discovery may be distorted by sources of influence external to the consensus process. Scientists may make less veridical transformations of their perceptions if these perceptions were based on observations of others or on a preformed external consensus.

Further, groups of scientists may be more resistant to technological and ideological influences which may distort veridical empirical discovery. However, groups of scientists may also be more resistant to veridical perceptions which contradict paradigmatic preconceptions. Perceptual transformations which are less veridical under one paradigm are not necessarily less veridical under an alternative or emergent paradigm.

These conclusions are more relevant to the perceptual transformations which occur in normal science than in

scientific revolutions. As Kuhn suggests, the paradigm shift resembles a Gestalt transformation of a reversible stimulus. In contrast, scientists laboring in a normal science paradigm transform their perceptions more gradually relative to a standard based on paradigmatic preconceptions. When these perceptions are contradicted, as when anomalies arise, they require transformation of either the perception or the preconception. Subjects in the present experiment were required to transform their perception of the stimulus, not their conception of the equality of two lines. Similarly, scientists transform their perceptions to fit a paradigm, unless anomalies accumulate to a point where a paradigm shift is required to maintain veridical perception.

Further Research

Future research to test generalizations from the present research may involve substituting a stimulus which is more specific to a population and a domain of interest. Such a study would employ the design and procedure of the present experiment. For example, scientists may be presented with material in their respective disciplines in which a contradiction exists between a theoretical preconception and an empirical observation. Scientists would act either individually or in groups and would be instructed to restructure the perceptual stimuli which give

rise to the contradiction. Groups would do this by forming a consensus through discourse. The external influence produced by both a preformed consensus and a witnessed establishment of the observation would be introduced into the study. The stimulus selected for such a quasi-experimental field study must contradict a preconception, but this contradiction must have a definitive resolution which is unknown to the subjects.

The study of evidential reasoning in everyday explanations would employ a stimulus which is inherently ambiguous. Many of the facts accepted in human existence which are most worth studying have no veridical criteria. Thus, further studies of evidential reasoning must focus on empirical stimuli without veridical criteria as well as those with veridical criteria. The present experimental design and procedure may be used to study the construction of everyday reality by lay people. Lay people would be presented with an ambiguous stimulus lacking veridical criteria and asked to restructure their perception of it. For example, subjects may be presented with photographs of a human fetus and asked to reach consensus on whether it is a living being. The factual status of the human fetus has no definitive empirical criteria, unlike the Muller-Lyer stimulus. Therefore, this stimulus represents an empirical object whose objective content contradicts the factual

preconceptions both of those who believe the fetus is a living being and those who do not.

These subjects may be asked to restructure their perception of the photographs under the conditions of the present experiment. The photographs may be directly taken by them, by an observed other, or by remote others. Subjects would be instructed to restructure their perceptions in response to contradictions of their expectations. Moreover, the factual status of the fetus as a living being is less dependent on its empirical properties than on the expectations of its perceivers. Thus, as in the present experiment, normative influence will be expected to shape consensus and perception more than informational influence.

In further studies, especially those in which no objective standard exists, social psychological discourse analysis (Potter & Wetherell, 1986) would be employed to examine the social construction of empirical reality by both scientists and lay people. Such research would involve the naturalistic observation of discourse without experimental manipulation. Discourse analysis has been used to examine the process of scientific discovery (Knorr-Cetina, 1983). The study of the closure of scientific debates has been one of the major strategies in the sociology of scientific knowledge (Collins, 1983).

Discourse analysis has also been used to examine the lay person's explanation of everyday events (Antaki, 1988).

The reality by which people live is often more of an intersubjective product of discourse than a reflection of an objective state of affairs. For example, Pennington and Hastie (1986) demonstrated that subjects in mock juries exposed to the same trial construct different narrative structures to understand the evidence. However, the authors based this observation on structured interviews with individuals. This may have produced a distorted and incomplete picture of the construction of reality by juries whose processes are collective, interactive and discursive. The evaluation of evidence is influenced by conversational rules of discourse, such as those involved in response to leading questions (Swann, Guiliano, & Wegner, 1982). Swann, et al found that leading questions cause subjects to infer that conjectures have an evidential basis.

An ontological understanding of reality is necessitated by divergent understandings of phenomena. An ontological approach may facilitate solutions to problems involving divergent understandings of reality which cannot be reconciled. Future research on evidential reasoning must demonstrate and explicate the process by which empirical reality is an ontological product of discourse. Therefore,

the study of the social construction of everyday reality must itself be based on consensual rather than empirical criteria (Rettig, 1988). According to Rettig, the symbolic nature of discourse requires that discourse analysis take a hermeneutic approach.

Rettig (in press) used discourse analysis to examine people's use of evidential warrants to support their factual claims made in everyday discourse. Rettig's studies suggest that the social construction of reality through discourse may involve the validation of facts using opinions rather than the justification of opinions with facts. The use and selection of evidence by lay people in the construction of their ontological reality does not require that ontological reality correspond to objective facts. Therefore, the use of empirical criteria in the study of the construction process distorts the understanding of the construction process.

An ontological understanding is necessary to avoid the imposition of a metaphysical reality as a criterion for human experience. This imposition has been the tendency of positivistic approaches to social psychology, such as attribution theory (Gergen, 1982). The social psychological analysis of discourse must aim towards an ontological understanding of the intersubjective basis of the human experience of reality.

Conclusion

The present experiment demonstrated that evidential reasoning involving the formation of consensus through discourse can produce relatively veridical perceptions of reality. The veridical perception produced by evidential reasoning in discourse may be distorted by external influence. Further research must examine the discursive and consensual processes which provide a context for evidential reasoning. However, such research requires an ontological and hermeneutic approach because of the diversity of human experiences of reality.

Table 1

ANCOVA Summary Table for Change in Stimulus

Source of Variation	SS	MS	df	F	Prob.
Covariate					
Initial Position	12.4	12.37	1	11.15	.002
Main Effects					
Group-Individual	4.8	4.79	1	4.32	.04
Stimulus Establishment	11.2	5.60	2	5.04	.01
Interaction					
Group X Stimulus	3.36	1.68	2	1.52	n.s.
Explained	30.4	5.07	6	4.57	.001
Residual	54.4	1.11	49		
Total	84.8	1.54	55		

Table 2

ANCOVA Summary Table of Illusion Magnitude

Source of Variation	SS	MS	df	F	Prob.
Covariate					
Initial Position	11.4	11.36	1	10.24	.002
Main Effects					
Group-Individual	4.8	4.79	1	4.32	.04
Stimulus Establishment	11.2	5.60	2	5.04	.01
Interaction					
Group X Stimulus	3.4	1.68	2	1.52	n.s.
Explained	29.4	4.90	6	4.41	.001
Residual	54.4	1.11	49		
Total	83.8	1.52	55		

Table 3

Mean Change in the Initial Stimulus by Group and Initial Stimulus Establishment.

	Initial Stimulus Establishment			
	Remote Consensus	Observed Confederate	Self (control)	All
Groups				
Mean	.06	.60	.86	.46
S.D.	1.31	.88	1.69	1.28
Individuals				
Mean	-.18	-.79[a,b]	.70[a,b]	-.03
S.D.	.94	.65	1.36	1.21
All				
Mean	-.09[c]	-.33[c]	.74[c]	.13
S.D.	1.07	.98	1.40	1.24

Note. Positive signs indicate change toward accuracy, negative signs indicate change toward illusion.

a Significant difference ($p<.05$) found in range tests of individual condtions.

b Significant difference ($p<.05$) found in range tests of six independent conditions.

c Significant difference ($p<.05$) found in range tests of combined group and individual conditions.

Table 4

Mean Illusion (in centimeters) by Group and Initial Stimulus Establishment.

	Initial Stimulus Establishment			
	Remote Consensus	Observed Confederate	Self (control)	All
Groups				
Mean	3.46	2.88[a]	2.62[a]	3.03
S.D.	1.28	.88	1.30	1.16
Individuals				
Mean	3.69[b]	4.25[a,b]	3.04[a,b]	3.61
S.D.	.95	.66	1.54	1.24
All				
Mean	3.60	3.79[c]	2.93[c]	3.43
S.D.	1.06	.98	1.46	1.23

a Significant difference ($p<.05$) found in range tests of six independent conditions.

b Significant difference ($p<.05$) found in range tests of individual condtions.

c Significant difference ($p<.05$) found in range tests of combined group and individual conditions.

Table 5

ANOVA Summary Table for Change in Stimulus

Source of Variation	SS	MS	df	F	Prob.
Main Effects					
Group-Individual	4.30	4.30	1	3.33	.074
Stimulus Establishment	13.5	6.74	2	5.21	.009
Interaction					
Group X Stimulus	3.8	1.9	2	1.47	n.s.
Explained	20.2	4.04	6	3.12	.02
Residual	4.62	1.29	50		
Total	84.8	1.54	55		

Table 6

ANOVA Summary Table for Illusion Magnitude

Source of Variation	SS	MS	df	F	Prob.
Main Effects					
Group-Individual	5.4	5.38	1	3.98	.03
Stimulus Establishment	9.1	4.56	2	3.37	.04
Interaction					
Group X Stimulus	2.99	1.50	2	1.11	n.s.
Explained	16.2	3.24	6	2.39	.05
Residual	67.59	1.35	50		
Total	83.7	1.52	55		

Table 7

Number of subjects randomly assigned to each condition

Initial Stimulus Establishment	Groups*	Individuals	All
Remote Consensus	7	11	18
Observed Confederate	6	12	18
Self (control)	5	15	20
All	18	38	56

Note. Each group consists of three subjects

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