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Keyser, Martin Jakobus

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The Effect of Individual Cultural Characteristics on Communication in a Research and Development Environment in South Africa

Martin Jakobus Keyser

A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration

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ABSTRACT

Knowledge has become a key resource in the present economy, and sustainable strategic advantage can be created through sharing and communication of information in a competitive business environment. Communication provides the basis for the transition of ideas, direction and ultimately strategy in an organisation. For this reason, communication has become more strategic than ever before.

This study is focussed on the communication behaviour of individuals in a high-tech Research and Development environment. It is suggested that R&D organisations face significant challenges regarding the achievement of effective business communication because of the individual characteristics of employees found in R&D organisations. This study has two main objectives. Firstly, it makes use of grid-group culture theory to type employees in a R&D organisation according to four possible cultural biases (also called worldviews of ways of life), namely individualists, hierarchists, fatalists and egalitarians. Secondly, the study aims at establishing if there is any relationship between the cultural bias groups of individuals in a R&D organisation and their perceptions of and preferences for communication frequency, source and channel.

The data for this quantitative study was obtained by convenient sampling of one of the largest R&D organisations in South Africa. A questionnaire for measuring cultural biases, communication perceptions and communication preferences was distributed to all 600 employees of the R&D Division of Sasol Technology (Pty) Ltd. The data was evaluated using acceptable statistical techniques, which included 1-way ANOVA, 2-way ANOVA and χ^2 tests for independence.

The findings of this study indicate that employees in the R&D environment are

predominantly individualists, which in itself poses a significant challenge to management, human resource and communication specialists due to the characteristics and world view if individualists. The fatalistic cultural bias in the R&D environment that was sampled was found to be negligible.

It was further found that no relationship exists between the cultural bias groups of individuals in the R&D organisation and their perceptions of communication frequency, source and channel. These findings indicate that no communication perception differences exist between individualists, hierarchists and egalitarians, as the literature on culture theory and communication behaviour would suggest. Regarding communication preferences, a limited number of relationships were found between the cultural biases and the preferences for communication frequency, source and channel. The communication behaviour of the different cultural groups (i.e. individualists, hierarchists and egalitarians) were found to be consistent with grid-group culture theory. The prevalence of fatalists in the R&D organisation was found to be extremely low.

From the findings of this study, it is concluded that grid-group culture typology is perhaps not the most appropriate framework for gaining a better understanding of communication behaviour, as the literature suggests. The findings also suggest that there are distinct differences in how employees would respond to questionnaires regarding their perceptions and preferences for communication. Furthermore, communication surveys should be very clear about what is measured to ensure that the results are not clouded by any uncertainty as a result of perception differences.

DECLARATION

I, Martin Jakobus Keyser, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Martin Jakobus Keyser

Signed at ……

On the …….. day of …… 2009

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- Firstly, my family, for their support, motivation and understanding.
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1 INTRODUCTION

1.1 Purpose of the study

The purpose of this study is to determine if grid-group culture theory can be used as a framework for better understanding the interaction between organisational culture and the perceptions of and preferences for communication in the corporate R&D environment in South Africa.

Firstly, the cultural biases of R&D employees will be determined according to the classical grid-group culture typology framework originally proposed by Mary Douglas (Douglas, 1982), thereby typing the employees into one of four groups, namely individualism, hierarchism, egalitarianism or fatalism. Secondly, appropriate statistical methods will be used to investigate if there is any relationship between the cultural biases of individuals in a R&D organisation and their perceptions of the communication process with regards to frequency, source and channel. Thirdly, appropriate statistical methods will be used to investigate if there is any relationship between the cultural biases of individuals in a R&D organisation and their preferences for the communication process with regards to frequency, source and channel.

The study will be based on a quantitative analysis of data obtained from respondents working as employees and managers in a major technical R&D organisation in South Africa.

1.2 Context of the study

In the present economy, knowledge has become a key resource (Bhatt, 2002), and sustainable strategic advantage can be created through sharing of

information and the development of the professional intellect (Smith and Rupp, 2003). Most organisations face the challenge of creating a knowledge-based business which relies on the knowledge of individuals for their success (Kinnear and Sutherland, 2000). Communication provides the basis for fluid transition of ideas, direction and ultimately strategy in an organisation, and leaders must set the strategy and communicate it to employees (Zwell, 2000). Goodman (2001) is of the opinion that communication has become more strategic than ever before.

The literature references to “high-tech” working environments are not consistent or well defined in the literature with regards to its characteristics and that of its employees (Twomey & Quazi, 1994). The characteristics of a high-tech environment, according to Twomey & Quazi (1994), are those of a dynamic environment, unexpected change, competition for leadership and survival, non-routine jobs, and a high industry growth rate. Twomey & Quazi are of the opinion that high-tech employees have specialised training and education for complex job requirements, and characteristics of high-tech employees include a capacity for status and social presence, internal motivation, work for job satisfaction, valuing technical work and expertise, an interest in challenging work, a need for professional growth, and a need for recognition of their uniqueness (see Twomey & Quazi (1994) for references to these characteristics). Twomey and Quasi mention “scientists” and “PhD’s”, and although no specific reference is made to R&D, it can be concluded that the R&D environment and its employees have characteristics that are typical of the “high-tech” definition of Twomey & Quazi (1994).

In this research study it is argued that a high-tech working environment, like a R&D organisation, faces significant communication difficulties if barriers to effective communication exist, and on the contrary, the organisation will benefit substantially if effective communication is enabled. The problems that may arise from inappropriate communication are discussed in the literature review, with specific focus on internal communication and organisational culture. It will be shown that communication influences, and is influenced by, a vast array of

management and organisational aspects, which include effective leadership, diversity management, vision and strategy, culture, trust, motivation, innovation and knowledge management. Although these aspects are well covered in the general management literature, the literature review revealed that very little research had been done on communication specifically in R&D-type organisations which have a unique make-up in terms of employee skills, employee diversity, culture and intellectual demands on knowledge workers in this environment. The literature further suggests that the way individuals communicate within an organisation is closely linked with the organisational culture, therefore communication behaviour cannot be understood without considering the cultural context within which individuals communicate (Smallman & Weir, 1999). One of the ways to understand the cultural context of communication is through grid-group culture theory (Smallman & Weir, 1999).

1.3 Problem statement

1.3.1 Main problem

The purpose of the research is to identify if there is any relationship between the cultural characteristics of individuals in a high-tech corporate research and development environment and their perceptions of and preferences for communication.

1.3.2 Sub-problems

The objective of this study is to explore the following sub-problems:

1. The first sub-problem is to establish the cultural characteristics (or biases) of individuals in the corporate R&D environment.

2. The second sub-problem is to determine if there is any relationship between the cultural characteristics of employees in a R&D environment and their perceptions of communication.

3. The third sub-problem is to determine if there is any relationship between the cultural characteristics of employees in a R&D environment and their preferences for communication.

1.4 Significance of the study

Despite the fact that a large body of literature exists on the topic of communication in organisations, limited information exists which attempts to link communication behaviour of employees with the unique personal characteristics of the employees within the organisation, particularly in high-tech R&D organisations. The literature is clear about the fact that personal characteristics play a major role in organisational communication (Ricks & Gow, 1987; Reitz, 1977; Sigband & Bell, 1989), yet quantitative studies is this regard are lacking. Although Smallman & Weir (1999) suggested grid-group culture theory as a framework for understanding and describing communication behaviour in an organisational context, a qualitative study to support this does not exist. This study aims to fill this gap by not only studying how employees perceive and prefer their organisational communication environment, but to investigate if the cultural biases (or worldviews) of employees in a R&D environment are in any way related to their communication perceptions and preferences.

This study further supplements the gap that exists regarding the difference between the perception of and the preference for particular communication dimensions, since no clear distinction is made between the concepts of perception and preference in the literature on organisational communication (Allen, 1967; Reitz, 1977; Ricks & Gow, 1987; Sigband & Bell, 1989; Thill & Bovée, 1993; Tagiuri, 1996; Robbins, 2005).

It is believed that this study will provide guidance to managers and human resource specialists for the achievement more effective communication within organisations which are dependent upon the technical skills of engineers and scientists for maintaining and sustaining the organisation's competitive advantage.

1.5 Delimitations of the study

This study is limited to internal organisational communication, and external or intra-organisational communication falls outside the scope of this study. The communication dimensions which fall inside the scope of this study are those of frequency, source and channel of communication, and both vertical communication (between managers and sub-ordinates) and horizontal communication (between colleagues and peers) are within scope. The following aspects pertaining to the content of the message fall outside the scope of this investigation:

- Understandability
- Accuracy
- Usefulness
- Consistency
- Trustworthiness

The identification of an optimal communication channel mix also falls outside the scope of the current study, although the results from this study will give some indications in this regard.

Lastly the study is delimited to exclude the possible effects of demographic variables on communication behaviour. However, the gathering of typical

demographic information was included in the survey for purposes of sample description and completeness of the data set, should demographic data be required by other researchers who may want to use make use of the data set for further research.

1.6 Definition of terms

The following definitions are relevant to the current study:

Cultural theory: "Cultural theory aims at explaining how people perceive and act upon the world around them" (Oltendal et al, 2004:5).

Grid-group culture theory: A theoretical basis whereby an individual's involvement in social life can be described by two dimensions of sociality, namely *group* and *grid* (Gross & Rayner, 1985; Thompson et al, 1990; Mamadouh, 1999; Mitleton-Kelly, 2004).

Group: "Refers to the extent to which an individual is incorporated into bounded units. The greater the incorporation, the more individual choice is subject to group determination" (Thompson et al, 1990:5).

Grid: "Denotes the degree to which an individual's life is circumscribed by externally imposed prescriptions. The more binding and extensive the scope of the perceptions, the less of life that is open to individual negotiation" (Thompson et al, 1990:5).

Cultural bias: Also referred to as a "worldview" or "way of life", which is determined by shared values and beliefs (Dake, 1991, 1992). The two dimensions of grid and group give rise to four combinations, or "ways of life", namely individualism, fatalism, hierarchy, and egalitarianism.

Grid-group culture typology: A framework for typing individuals to determine their adherence to a particular cultural bias (or way of life) (Thompson et al, 1990).

1.7 Assumptions

This research study is subject to the following assumptions:

- It is assumed that variables and relationships that are investigated are not subject to random events, and that certain cause-effect relationships can describe the phenomenon that is investigated (Leedy & Ormrod, 2005). In this study, it is assumed that there are is a relationship between certain cultural characteristics and the communication behaviour within the population that is studied. The study aims at uncovering these relationships through the application of an appropriate research methodology.

- It is accepted that various different perspectives on the research problem are possible, but it is assumed that the perspective that is taken in this study is objective and capable of describing the factors underlying the research problem. Since the researcher is also employed in the R&D organisation which will be studied, ensuring objectivity and an unbiased perspective is indeed challenging. It is assumed that adequate objectivity can be achieved by making use of instruments from the open literature, like accepted questionnaires, frameworks, models and appropriate statistical techniques, coupled with an extensive literature survey on the topic. There are also independent internal communication audits against which findings from this study can be compared.

- It is assumed that grid-group culture theory (Thompson et al, 1990) is a valid framework for describing the cultural bias (or ways of life) of individuals working within the environment that is studied. This study does not aim to prove the validity of the grid-group culture typology, nor its relationship with demographic variables.

- It is assumed that the relationships between cultural biases and communication behaviour of employees in the Sasol Technology R&D Division are not significantly different from relationships which may be found if other high-tech R&D organisations are sampled.

- It is assumed that differences in the respondents' cultural biases and personalities do not affect their willingness to partake in this study. It is therefore assumed that the responses are not skewed towards any particular cultural bias. The risk of not meeting this assumption can be minimised by ensuring a large enough sample size, and by using a culture typology framework which is known to comply with the requirements of internal and external validity.

2 LITERATURE REVIEW

2.1 Introduction

Organisations today are becoming increasingly complex, and the complexities of communication are often taken for granted (Smallman & Weir, 1999). It should be acknowledged that no organisational system can function without constant communication (Ricks & Gow, 1987; Sigband & Bell, 1989). In fact, Ricks & Gow (1987) states that communication is the link that connects organisational departments and individuals together in order to achieve organisational goals. Communication is required to convey the organisational goals to individuals, and more specifically how each individual can contribute to reach these goals (Ricks & Gow, 1987). However, if communication distortions occur, or if effective communication does not occur, it becomes difficult to achieve organisational goals, and if communication does not occur al all, goal accomplishment may even become impossible (Ricks & Gow, 1987). Under such conditions of uncertainty levels within the organisation will increase (Robbins, 2005), which has negative effects on employee satisfaction and organisational performance. Understanding communication in the complex organisational environment is therefore of primary importance to managers and employees for achieving high levels of organisational performance. Communication in complex organisations is an “achieved process”, and requires constant attention and revision so that its importance is not neglected (Smallman & Weir, 1999).

Goczol & Scougeau (2003) state that communication concerning industrial project marketing (the space industry and engineering are mentioned as examples) does not lead to a lot of research and publications, implying that the body of knowledge in this field it is not that rich and extensive. The literature search for this study confirmed this notion, as very little research information could be found which specifically address communication in high-tech R&D

environments. The literature about communication in organisations overlaps with a number of fields concerned with organisational management, for example fields concerned with effective leadership, knowledge workers, and organisational strategy. An understanding of organisational communication can thus be attained from a study of these literature fields (Kelly, 2000).

In the literature review that follows, the aspects related to communication which are believed to have significance to high-tech R&D organisations, are discussed. It will be shown that communication in organisations is intimately linked to organisational culture, hence a substantial section of the literature background discussion will focus on organisational culture and the relevance of individual cultural biases of individuals, which collectively make up the organisation's culture.

2.2 Background discussion

2.2.1 Definition of communication

Numerous definitions for communication can be found in the literature. The following definitions for business communication are cited as examples which are appropriate to the present study:

- "Communication is the use of words, letters, symbols or similar means to achieve common or shared information about an object or occurrence" (Cherry, 1961, as quoted by Reitz, 1977:341).
- "Communication is the exchange of information that is mutually understood" (Ricks & Gow, 1987:2).
- "The complex process of human communication involves senses, experiences and feelings. It is more than just letters, reports, telegrams, telephone conversations, and interviews. It is the action of people

talking, listening, seeing, feeling, and reacting to each other, their experiences, and their environment" (Sigband, & Bell, 1989:7).

- Organisational communication is "the process by which information is exchanged and understood by two or more people, usually with the intent to motivate or influence behaviour" (Daft, 1997:560, as quoted by Kelly, 2000).

2.2.2 The components of the communication process

When the business communication process is analised, it can always be broken down into at least four components, i.e. (1) a sender who wishes to communicate something, (2) a message that needs to be communicated, (3) a receiver who receives the message, and (4) a feedback loop between the sender and receiver which ensures that the message was interpreted as intended (Reitz, 1977; Ricks & Gow, 1987; Thill & Bovée, 1993). Other components or elements that play a role in communication include background and experiences which humans bring into a message, the channel that is used for the message, and barriers, sometimes also called static, which interfere with effectively sending or receiving the message (Sigband, & Bell, 1989). The barriers to communication will be discussed in a later section.

Communication can further be classified as internal (inside the organisation) or external (with other organisations), and it can be formal or informal (Sigband, & Bell, 1989). Employees often revert to informal or unofficial communication when their need to know is not satisfied, and they are left with unanswered questions (Sigband, & Bell, 1989). Internal communication, which is the flow of communication within the boundaries of the organisation, may be upward to superiors, downward to subordinates, or horizontal to peers (Ricks & Gow, 1987; Robbins, 2005). The following explanation of the different directions of communication is offered by Ricks & Gow (1987):

Downward communication: Most of the communication within an organisation is downward, because managers have to provide information about the organisation's goals and policies, and managers have to advise, inform, direct, instruct and evaluate subordinates. The communication channels for downward communication include posters, bulletins, periodicals, letters, loudspeaker system, presentations, road shows and information sessions. The grapevine is seen as a major (and very fast) communication channel, but unfortunately prone to distortion as the message is passes from one individual to the next. The effectiveness of communication is largely determined my how willing managers are to share information openly, and this enforces employees to trust their managers and to rely on mangers for the main source of information, thus relying less on the grapevine for information.

Upward communication: This is the process whereby subordinates provide information to managers through upward communication.. In recent times the involvement of employees in decision making, also referred to as participative management, has gained importance. The effectiveness of upward communication is largely determined by the attitude of managers to participative management, and the confidence (or trust) that mangers have in their employees. The channels for upward communication include reports, complaint and suggestion boxes, questionnaires and surveys, open-door policy, special informers, and the grapevine.

Horizontal communication: With horizontal communication the emphasis is on sharing or exchanging of information between peers at roughly similar levels in the organisational hierarchy. A characteristic of horizontal communication is that it is fast because it bypasses or short

circuits the more formal communication route from one employee to his/her manager and back to another employee, thus reducing information loss and distortion of the message. This characteristic offers an opportunity, but at the same time poses a challenge because of the danger that horizontal communication may substitute both upward and downward communication. Managers have to be aware of this type of communication, and people in the organisational hierarchy must be made aware that horizontal communication is non-threatening and that their authority is not eroded by it.

2.2.3 Communication of vision and strategy

Communication provides the basis for fluid transition of ideas, direction and ultimately strategy in an organisation, and leaders must set the strategy and communicate it to employees (Zwell, 2000). In an information driven age, communication is an integral part of the corporate strategy (Goodman, 2001). Pyöriä (2005) points out that the existing knowledge about human behaviour is far less than adequately applied, and encourages managers to pay less attention to the latest communication technology and more attention to human relations. Sustainable strategic advantage can be created only through sincere sharing of information and the development of the professional intellect (Smith and Rupp, 2003).

In today's competitive business environment organisations have to be flexible and adaptable to survive (Worrall & Cooper, 2001). Owusu (1999) points out that communication and employee involvement is of strategic importance for agile world-class management. Owusu (1999) regards communication and trust between management and workers as prerequisites for a world-class organisation. Company goals should flow from the vision and strategy, and Owusu (1999) argues that effective communication is the foundation for employee involvement in formulating and implementing organisational goals.

Sterling (2003) suggests that strategies fail as a result of insufficient understanding of the strategy among those who have to implement it. Kelly (2000) suggests that having a communicated vision has an empowering effect on employees, while Smith and Rupp (2003) believe that loyalty is engendered through communication with knowledge workers. The benefits of empowerment and loyalty in the knowledge worker environment are well documented (e.g. Kinnear & Sutherland, 2000; Coleman, 1996).

From the literature on communication of vision and strategy, it is concluded that employees want to be well informed about where the organisation is going, and miss-communication or lack of communication in this regard is one of the primary reasons employees not trusting management.

2.2.4 Communication and employee involvement

Communication is a two-way process, and therefore it is not adequate that management communicate vision, strategy and goals to employees, but employees have to communicate with management to provide feedback, and have to share information with colleagues in work teams. Employee communication is achieved through employee involvement, where the entire firm's workforce is involved in improving the working environment and product quality through cooperative relationships and open communication (Owusu, 1999). Owusu (1999) points out that proper communication of ideas and/or information is a learned art, and therefore employees in working teams must be trained to communicate effectively. These training programs must be aligned with company strategy to ensure the desired results. Smith and Rupp (2003) argue that the way in which the various professional groups interact and communicate within the organisation is just as critical as the knowledge that is created and transferred. It is therefore apparent that an organisation should be a catalyst for such networking, instead of creating barriers for its development (Smith and Rupp, 2003).

2.2.5 Communication and diversity

Diversity is a word which can potentially mean different things to different people. Sadri & Tran (2002) cited a number of references and summarised that diversity encompasses issues like culture, gender, nationality, sexual orientation, physical abilities, social class, age, socioeconomic status, and religion. In a highly specialised environment like a R&D organisation, where the workforce is highly diverse in terms of skills, education and culture, and this diversity can be expected to be more enhanced than what one would find in organisations in general.

While there seems to be general agreement in the literature about what diversity means in an organisational environment, there is no general agreement about how to deal with such diversity (Sadri & Tran, 2002). The literature on diversity suggests that diversity can be problematic for organisations to manage, and can have positive or negative impacts on organisational performance (Sadri & Tran, 2002; Evans & Carson, 2005). If properly managed, organisations may benefit from functionally diverse work groups by having access to expertise and greater cognitive resources otherwise not available in homogeneous work groups (Evans and Carson, 2005). Despite these advantages, Evans & Carson (2005) point out that the performance of diverse work teams is inconsistent and work teams often fail to perform to their full potential. Sadri & Tran (2002) propose that improvements in openness of supervisor-subordinate communication will assist organisations towards managing diversity by promoting integration and equality in the workplace. For this an effective communication strategy is required. Sadri & Tran (2002) conclude from their study that for a diversity management program to succeed, managers and supervisors need to demonstrate their commitment by communicating the importance and benefits to all employees throughout the organisation. It is therefore concluded that communication is an enabler of effective diversity management.

Cultural diversity is an important aspect which needs to be managed in modern organisations. Nixon & Dawson (2002) propose that cross-cultural communication training is required to resolve inter-cultural communication problems. Cultural training can reduce the hesitancy to communicate and can improve the efficiency of communication between cultural groups (Nixon & Dawson, 2002). Dombai (1999) explored the influence of organisational culture on diversity management in multi-cultural organisations, and suggests that the experiences of employees in organisations are more related to organisational diversity than race, gender or age. Dombai (1999) concludes that organisational culture should be the focus of diversity management, and proved that a well-planned strategic approach to diversity management should have communication as its pivotal point.

One of the negative aspects of diversity is employee perceptions of inequality in the workplace (Sadri & Tran, 2002). It will be discussed later that cultural diversity can influence communication in a positive or negative way, and a better understanding of the interaction between cultural diversity and communication forms the basis of the current research study.

2.2.6 Communication and organisational change

A dynamic and constantly changing environment is typical of a R&D organisation, therefore it is important to take note of the literature on the interaction between change and communication in organisations. The obvious importance of communication in change management is addressed by a large literature base (see Trim & Lee (2004) for a review). Goodman (2001) discusses the intimate connection between change and communication, and suggests that change is critical for the survival of organisations. April (1999) points out that where trust is high, change is managed more effectively, and where trust is low, communication and co-operation suffer, and the tendency for

power play increases. April (1999) is of the opinion that change occurs within conversation and dialogue, and is a necessity within today's organisations.

Goczol & Scougeau (2003) summarise the project environment as being unique, complex and discontinuous. This is certainly true for the R&D environment where each project is different from the next, highly complex due to the technological challenges, and discontinuous because the number and nature of the projects change continually. Goczol & Scougeau (2003) argue that in such an environment internal communication should be developed as a tool to manage the challenges mentioned, since a high degree of adaptability is asked of employees.

Elving (2005) focussed on the role of communication during organisational change, and points out that although there is an enduring interest in studying internal communication during organisational change, there is still little or no empirical research on the topic. Elving (2005) points out that resistance to change and the uncertainty which change brings can be overcome through communication. Elving (2005) concluded that communication is vital to the effective implementation of organisational change, and that poorly managed change communication results in resistance to change and exaggerated negativity towards change.

2.2.7 Communication in research and development organisations

The literature study revealed that limited quantitative communication studies exist for R&D type organisations. One quantitative study that was found, is a field study on communications in the organisational R&D environment carried out by researchers of M.I.T. (Allen, 1967), and the results of this study are summarised by Reitz (1977):

- Engineers and scientists receive external messages more frequently than internal messages. The reasons for this were ascribed to the fact that external messages give information with a quality superior to that of internal information, and the fact that external information is easier accessible than internal information. The obvious implication for managers is to make the use of higher quality information easier and more accessible.

- Status was found to be important, since PhD's communicated more frequently PhD's than with non-PhD employees.

- A strong relationship was found between social and technical communication, indicating that work is more frequently discussed with friends than with others who are not friends (fewer psychological barriers).

- Engineers were found to communicate more easily with those in close physical proximity in the workplace (fewer physical barriers).

- Technological gatekeepers or opinion leaders are people who are regarded by others as opinion leaders and valuable sources of information. These few people are regarded as opinion leaders not due to individual characteristics, but because these people used more personal friends outside the laboratory, read more work-related literature, attended more meetings, and published more papers.

- Information flows from the external environment into the organisation via the gatekeepers, from where the internal communication process distributes the information further, with the gatekeeper acting as a link between individuals and the outside world.

Within the Sasol Technology Research and Development Division, a number of internal communication audits and surveys were conducted to measure communication efficiency (Business DNA, 2005; Yannakou, 2005; Sasol, 2005;

Sasol, 2007). These audits and surveys, like the one of Allen (1967) reported above, suffer from two major shortcomings, namely (a) the communication behaviour of individuals are not linked to any personal characteristics of the individual, and (b) the studies do not clearly distinguish between the concepts of perception and preference. The remaining part of this literature review focuses on these shortcomings.

2.3 Culture typology theory

From the background literature presented above, it is evident that the personal characteristics of the individuals which are involved in the organisational communication process are largely disregarded in studies which are aimed at the improvement of communication behaviour. This section focuses on the literature which describes the behaviour of individuals according to grid-group culture theory, and concludes with a typology framework for describing an individual's cultural bias or "way of life".

2.3.1 Introduction to grid-group culture theory

Over the years, a number of different cultural typologies and theories were proposed in an effort to grasp and understand the underlying cultural dimensions that drive the behaviour of individuals and groups in different environmental contexts. Hofstede's cultural typology is well known, where culture is defined by the dimensions of power distance, uncertainty avoidance, masculinity and individualism (Hofstede, 1980; Hofstede, 2001). The typology proposed by Triandis (1995) considers the dimensions of vertical and horizontal collectivism and individualism, and the four possible combinations describe the culture as being either unique, cooperative, dutiful, or achievement oriented (Gouveia, Clemente & Espinoza, 2003). Of particular interest to this study, is

the grid-group culture theory proposed by the social anthropologist Mary Douglas in 1973 (Thompson et al, 1990).

In their book *Culture Theory* Thompson et al (1990) "explores the different perceptual screens through which people interpret or make sense of their world and the social relations that make particular visions of reality seem more or less plausible" (Thompson et al, 1990:xiii). The authors build on the pioneering work of their teacher, the anthropologist Mary Douglas (Douglas, 1982). Thompson et al (1990) view "culture" as "a way of life" which they argue to be a viable combination of "cultural bias" and "social relations". "Cultural bias" is said to be determined by shared values and beliefs (also referred to as "worldviews" or "cosmologies" by Dake, 1991), while "social relations" defines five patterns of interpersonal relations, i.e. hierarchical, individualist, egalitarian, fatalist and hermit (Dake, 1991). Grid-group culture theory aims to explain the behaviour or "way of life" of an individual as a socially viable combination of cultural biases and social relations (Dake, 1991). The terms "way of life" and "cultural bias" are often used interchangeably in the literature on culture theory. Perceptions play an important role in determining the adherence to a particular cultural bias, to the extent that cultural biases are said to be protected by filtering facts through a perceptual screen (Burke, 1935, as quoted by Thompson et al, 1990). In this regard, the literature on culture theory is consistent with the literature about communication perception (to be discussed shortly), in the sense that perceptions are influenced by the individual's world view which was shaped by the individual's background and experience.

Although "culture" is a term commonly used to describe the behaviour of groups, it is the behaviour of individuals within the group which ultimately determines the collective behaviour of the group (Hofstede, 1980; Rippl, 2002). The grid-group typology claims to capture both the individuation dimension (the grid) and the social incorporation dimension (the group) (Mamadouh, 1999).

The theoretical basis of grid-group culture theory is the argument that an individual's involvement in social life can be described by two dimensions of sociality, namely group and grid (Gross & Rayner, 1985; Thompson et al, 1990; Mamadouh, 1999; Mitleton-Kelly, 2004). Referring to Douglas (1982), Thompson et al (1990:5) defines the "grid" and "group" dimensions as follows: "*Group* refers to the extent to which an individual is incorporated into bounded units. The greater the incorporation, the more individual choice is subject to group determination. *Grid* denotes the degree to which an individual's life is circumscribed by externally imposed prescriptions. The more binding and extensive the scope of the perceptions, the less of life that is open to individual negotiation." The two dimensions of grid and group give rise to four combinations, or "ways of life", namely individualism, fatalism, hierarchy, and egalitarianism. A small number of individuals may behave rather neutral on the grip and group dimensions, and this is the "way of life" of a hermit who "escapes social control by refusing to control others or to be controlled by others" (Thompson et al, 1990:7). The five "ways of life" are shown in Figure 1, and is also referred to as "cultural biases" in some of the literature on grid-group theory (e.g. Dake, 1991, 1992), and "cultural biases" are also referred to as "worldviews" (Dake, 1991).

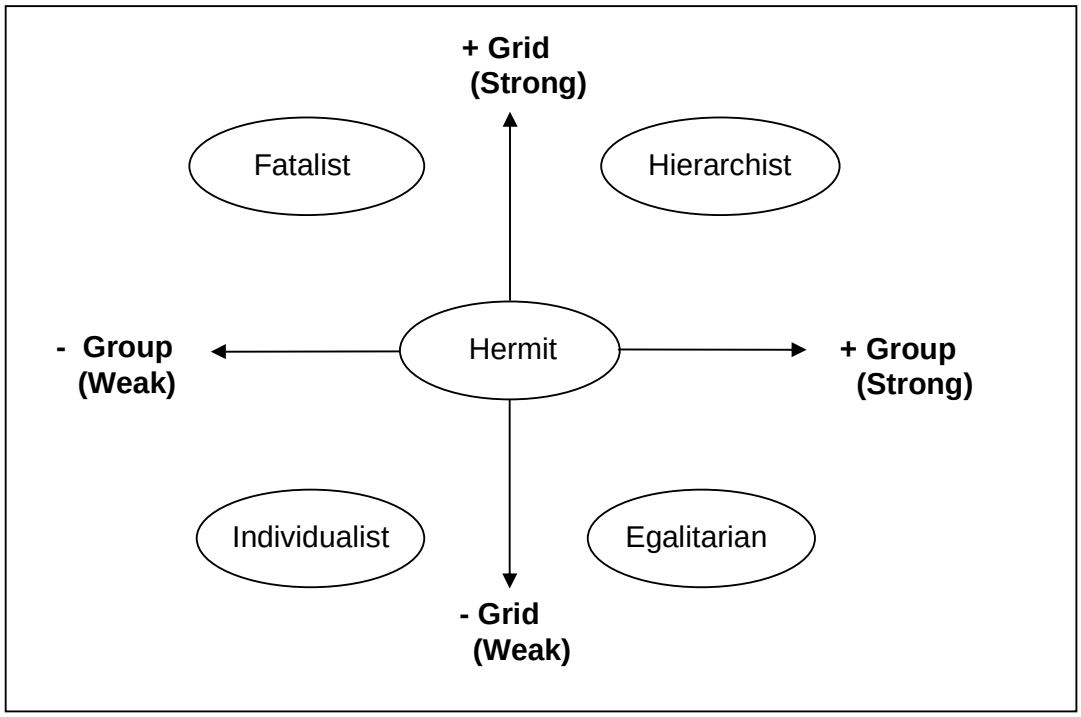


Figure 1: Grid-group culture typology of sociality (Thompson et al, 1990).

Since social control is a form of power, the individuals in the grid-group framework are either manipulated, or they will try to manipulate others (Thompson et al, 1990). The question is who is and who is not entitled to exercise power over others. Douglas (1982), as quoted by Thompson et al (1990:6), describes the cultural attributes of each of the five ways of life as follows:

> ***Egalitarian:*** "Strong group boundaries coupled with minimal prescriptions", "groups lack internal role differentiation", "relation between role members are ambiguous", "no individuals are granted the authority to exercise control over others by virtue of their position", "internal conflicts are difficult to resolve", "granted authority to exercise control over one another only by claiming to speak in the name of the group", "frequent resort to expulsion from the group in resolving intragroup

differences", "drastic nature of solutions tends to drive disagreements underground", "covert factions vying for control".

Hierarchical: "Strong group boundaries and binding perceptions", "individuals…..are subject to both the control of other members in the group and the demands of socially imposed roles", "has an armoury of different solutions to internal conflicts [including] up-grading, shifting sideways, downgrading, resegregating, redefining", "exercise of authority (and inequality more generally) is justified on the grounds that different roles for different people enable people to live together more harmoniously than alternative arrangements".

Individualistic: "Individuals who are bound neither by group incorporation nor prescribed roles", "all boundaries are provisional and subject to negotiation", "relatively free from control by others", "engaged in exerting control over others", "success is often measured by the size of the following person he can command".

Fatalistic: "Subject to binding prescriptions and are excluded from group membership", "fatalists are controlled from without", "like hierarchists, their sphere of individual autonomy is restricted", "may have little choice about how they spend their time, with whom they associate,.....where they live and work", "excluded from membership in the group responsible for making decisions that rule their life".

Hermit: "few individuals", "withdraws from coercive or manipulative social involvement altogether", "escapes social control by refusing to control others or be controlled by others".

The pioneering work of Douglas, which dealt with social environments from an anthropological perspective, was expanded by Thompson (Thompson, 1996, as referenced by Mitleton-Kelly, 2004) by superimposing the discriminators “competition” and “equality” onto the “grid” and “group” dimensions, and thus arriving at four ways of organising. Organisations can be thought of being made up of several “ways of organising” (Mitleton-Kelly, 2004). The “group” dimension thus indicates strong or weak competition, and the “grid” dimension indicates inequality (strong grid) or inequality (weak grid). The grid-group typology is therefore flexible in that it is not only applicable to social environments as originally proposed by Douglas, but can also be applied to an “organising” environment as shown by Thompson (1996). Numerous publications deal with the application of group-grid cultural theory to risk management and risk perception (e.g. Waldavsky & Dake, 1990; Dake, 1991, 1992; Rippl, 2002; Oltedal et al, 2004). Due to the uncertainty and high risk associated with high-tech R&D research projects, the body of literature on the application of grid-group theory to risk is regarded as relevant to the current study.

A recent reference to the use of grid-group typology is the work of Steeneveldt (2005). Steeneveldt used grid-group typology as an explanatory framework of behavioural strategies to identify the factor conditions that result in various coping strategies of individualists in a marketing organisation. The work of Steeneveldt built on prior work by Bendixen, who confirmed the application of grid-group theory to a sample of South African organisations and found that the dominant ways of life were that of individualists and hierarchists (Bendixen, 2002, as referenced by Steeneveldt, 2005). Bendixen postulated that various behaviours have not yet been confirmed by research (Bendixen, 2003, as referenced by Steeneveldt, 2005), and this motivated the qualitative interpretive study by Steeneveldt, who focussed on individualists in the South African organisational context.

It is important to note that the five ways of life are not a static condition, but that there is competition between the ways of life that create a state of constant disequilibrium (Thompson et al, 1990; Mamadouh, 1999; Bendixen, 2003; Steeneveldt, 2005). It can for example be expected that the incidence of fatalists and egalitarians will increase if an organisation experiences operational or transformational problems, and that bureaucratisation will trigger individualists to become fatalists (see Bendixen (2003) as referenced by Steeneveldt (2005) for an extensive list of postulates). According to cultural theory, societies need a mix of the three active ways of life, which include hierarchy, egalitarian and individualism, and organisations and societies will combine these ways of life in different proportions (Jackson & Philip, 2006).

A contentious discussion in the literature about culture theory is whether it is possible to measure culture with data obtained on an individual level (Rippl, 2002). There is enough evidence in the literature suggesting that measurements on an individual level do not measure culture directly, but that individual level measurements can measure processes that are connected to culture (see Hofstede (1980) and Rippl (2002) for a more detailed discussion). For purposes of this study, it is therefore accepted that individual level data can be sampled which will adequately portray the underlying organisational culture and social processes.

In the following sub-section it will be shown how the grid-group typology can be applied to understand the communication behaviour of individuals in an organisation, and how communication behaviour can be expected to change given certain environmental conditions.

2.3.2 Grid-group culture theory as a framework for organisational communication

Thompson et al (1990) poses a few interesting questions about communication towards the end of their book *Cultural Theory*. In particular, it is questioned how communication is possible between the five competing ways of life if they are so fundamentally different from one another. It is argued that communication is facilitated by the fact that there are only a limited number of ways of life, and that communication plays an important role in testing the individual's adherence to a particular way of life, which could lead to changes in perspectives and the way of life that is adhered to. Modern organisational environments create unique challenges to communication, and some aspects have been discussed before. Moon (1999) suggests that organisational hierarchies create additional managerial difficulties in control, coordination and communications in organizations. The distortion of information to meet organisational needs complicates communication in an organisational context, and complex organisations try to minimise potential problems of communication by appropriate recruitment, selection, training and socialisation (Smallman & Weir, 1999). Organisations "do" many "things" to enable effective communication, but, based on the literature discussed thus far, it appears that a more fundamental understanding of "why" individuals communicate in a particular fashion is often lacking.

Smallman & Weir (1999) turned to grid-group culture theory as a framework for understanding and describing communication behaviour in an organisational context. Smallman & Weir (1999) argue that in real life situations the ability of individuals to communicate is limited by their expectations, perceptions, and way of life that is adhered to. They also state that communication is largely a function of organisational culture. In the grid-group framework proposed by Smallman & Weir (1999), organisational culture and communication is integrated by superimposing "formality" on the "group" dimension, while the "viscosity" of communication is superimposed onto the "grid". In this framework, communication is conceived in terms of a fluid dynamics model where highly

viscous flow represents slow communication (due to binding perceptions in those particular cultures), and highly fluid flow represents rapid transmission of information in a less orderly manner. The grid-group culture/communication framework is presented in Figure 2.

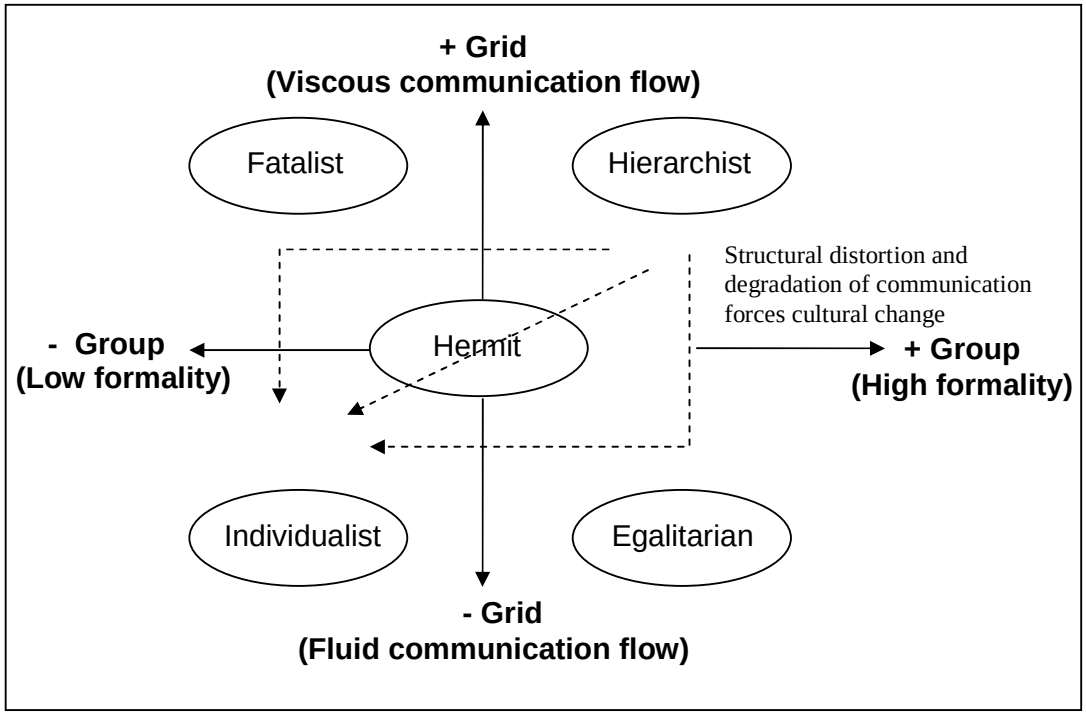


Figure 2: Grid-group culture/communication framework (Smallman & Weir, 1999).

As indicated in Figure 2, Smallman & Weir (1999) suggest that degradation of communication forces a cultural change towards convergence on individualism. Bendixen suggested that the incidence of fatalists and egalitarians increase as an organisation experiences operational or transformational problems (Bendixen, 2003, as referenced by Steeneveldt, 2005). Degradation of communication can occur for various reasons, and Smallman & Weir (1999) indicate that crisis, high risk, and organisational change situations are among those factors that may cause degradation of

communication flow. Degradation of communication, according to Smallman & Weir (1999), will have the greatest impact on bureaucratic organisations with hierarchical structures. Smallman & Weir (1999) describes communication in the fatalist culture as being restricted by rigidly separated departments or silos, but the authors do not explicitly discuss communication factors that may force fatalists to become more individualistic, and therefore this change should not be deduced from Figure 2. Steeneveldt (2005) found evidence of individualists changing to fatalists, which supports Bendixen's postulate that bureaucratisation will trigger individualists to become fatalists, and that this is the dominant state change (Bendixen, 2003, as referenced by Steeneveldt, 2005). It should however be acknowledged that the ways of life changes as described by Bendixen and Steeneveldt are not directly attributed to communication, and by the same token it is conceivable that the way of life changes which Smallman & Weir discuss in the context of communication degradation can be brought about by other environmental factors. It is arguable whether way of life changes are caused by communication distortions or whether communication distortions are resulted by way of life changes due to other environmental factors. In real life it is probably a bit of both, and a re-enforcing effect can be expected. The grid-group culture theory can possibly provide a simple but useful framework for better understanding the perceptions employees have about communication in a corporate R&D environment.

2.3.3 Proposition 1: Predominant cultural bias

It is proposed that the cultural biases (or ways of life) of employees in a high-tech R&D environment be typed according to grid-group culture typology, and that the predominant cultural bias is that of individualism.

2.4 The role of perception in organisational communication

In the next section the concept of communication perception will be explained, followed by a section explaining why perception is a major barrier in achieving effective communication.

2.4.1 Perception as a barrier to effective communication

Among the many barriers which prevent or hamper effective communication, there is consensus in the literature about the fact that differences in perception is a significant barrier to effective communication (Ricks & Gow, 1987; Reitz, 1977; Sigband & Bell, 1989; Smallman & Weir, 1999). Perception difference is often mentioned as the number one barrier for ineffective communication (e.g. Sigband & Bell, 1989). Reitz (1977) states that perception includes all those processes by which individuals receive information about their environment, including seeing, hearing and feeling. Reitz (1977) explains that perceptions arise due to individual stimuli being perceived in relation to recognisable or familiar patters. Reitz (1977) believes that both the physical and social environment in which an event is perceived can have a dramatic effect on the way it is perceived, even whether it is perceived at all.

Communication perception differences are caused by varying experiences, education, background (Ricks & Gow, 1987). Likewise, Reitz (1977) states that perceptions are affected by the object that is being perceived, the environment in which perception occurs, and the individual doing the receiving, while Sigband & Bell (1989) explains that, in viewing the same thing, individuals use prior experiences, knowledge and culture to make interpretations based on what they perceive. Smallman & Weir (1999) supports the notion that the ability to communicate in real life organisational situations is limited by the expectations and perceptions of the people in the organisation. Interestingly Ricks & Gow (1987) note that it is not only work experiences that influence the way that

people interpret messages, but also personal life experiences, for example the environment in which the person grew up. Differences in environmental background speaks to aspects like geographical areas to which the individual had been exposed, language, age, gender, culture, customs, family influences, lifestyle, social status and economic stand of the individual (Ricks & Gow, 1987; Sigband & Bell, 1989; Thill & Bovée, 1993).

In discussing individual characteristics that give rise to perception differences, Reitz (1977) states that gender, personality and culture are those most frequently studied, and despite citing the work of Tagiuri (Tagiuri, 1969, as quoted by Reitz, 1977) which states that no consistent relationships between personality variables and perceptual process were found prior to 1969, Reitz acknowledges that personal characteristics seem to be indirectly related to perception. Sigband & Bell (1989) hold a different view to Reitz (1977) by supporting that personality differences can be a barrier for effective communication.

Of particular importance to the current study, are numerous references to the fact that an individual perceptions depend on the individual's background and past experiences, whereby a particular view of the world is built up over time (e.g. Sigband & Bell, 1989; Thill & Bovée, 1993; Robbins, 2005). These individual differences in world views complicate the complex message decoding process, and create a communication barrier. In the discussion on grid-group culture theory, the concept of bias "world views" as a result of background and individual experiences was discussed, and it was indicated that substantial agreement exists between the body of literature on communication perception and the body of literature on grid-group culture theory on the topic of individual "world views" and what the factors are that contribute to an individual's view of the world.

Other barriers to communication, which are regarded less important to the current study, include the use of technical language and jargon, providing too much information (overload), giving conflicting signals, message filtering, message distortion, lack of interest and emotional state (Ricks & Gow, 1987; Sigband & Bell, 1989; Robbins, 2005). It should be noted that certain barriers to communication, including some aspects which affects communication perception, lie within the control of the organisation, but the organisation and its managers do not have control over individual characteristics of the receiver. Understanding which barriers exist, and knowing if they can or cannot be controlled, will add considerable value to any organisation.

Based on the discussion above, it is concluded that perception differences among individuals is likely to be an important barrier towards effective communication within an organisational environment. Perception differences are largely due to differences in individual characteristics brought about by different individual backgrounds, life experiences, views of life and personality. It therefore follows that, in order to gain a better understanding of perception barriers in organisational communication, a better understanding is required of the individual characteristics of the people working within that particular organisation. Communication behaviour within an organisation can thus be better understood with knowledge of the underlying cultural biases that affect the way in which individual employees behave and ultimately communicate with colleagues, superiors and subordinates.

2.4.2 Proposition 2: Relationship between cultural biases and communication perceptions

It is proposed that there is a relationship between the cultural characteristics of individuals working in a high-tech R&D organisation and their perceptions of communication.

2.5 Employee preferences for communication

In this section an attempt is made to address the gap that exists in the open literature about clarity between the concepts of “perception” and “preference”, particularly in relation to organisational communication behaviour.

2.5.1 Perception versus preference: What is the difference?

In order to demonstrate the lack of clarity between perception and preference in the communication literature, two literature studies are discussed as examples:

Example 1: Pena-Sanchez & Hicks (2006) performed a quantitative study on the perceptions of communications channels at the Texas A&M International University. Although the title to the paper, “*Faculty perceptions of communications channels: a survey*” clearly states the intention to study perceptions, the abstract contains the following statement: “In this survey, the relevant results are that faculty expressed a preference for …..” (Pena-Sanchez & Hicks, 2006:45). The paper continues to discuss the managerial implications of the study in the context of preferences rather than perceptions.

Example 2: In a recent paper that received the Jackson/Sharpe Award at the 11th International Public Relations Research Conference on 6 March 2008, O’Neil (2008) conducted a quantitative communication survey in a major international firm to examine the impact of various employee communication tactics and channels in engendering employee comprehension and action in support of the firm’s objectives. Although clearly stated that “preferred” sources of information were measured, it

can be argued that the questions used by O'Neil (2008) in fact measured "perceptions" and not "preferences". Employees were asked to rate 10 sources of information on a 5 point Likert scale with "very valuable" and "not at all valuable" as scale extremes, and in summarizing the results the author gave the following title to the results table: "*Correlations Among Employee Comprehension and Perceived Value of Information Sources" (O'Neil, 2008:13).* The paper is thus unclear about the distinction between the perceptions of and preferences for communication channels.

Examples of communication studies can also be found in the literature that succeed in making the distinction between perception and preference, yet they fail to make this distinction for the same aspects or dimensions of communication. A quantitative study by the Portland State University (2007) is a good example here, where the frequency of communication was measured for preference (but not perception), and the efficiency of communication (i.e. how well informed people are) was measured for perception (but not preference).

A quantitative survey by the Georgetown University (2006) attempted to measure both perceptions and preferences. Although the Georgetown University survey relates to the topic of service levels and not the topic of communication in the present study, it is noteworthy that the Georgetown University survey makes a very clear distinction between preference and perception in the way the questionnaire was formulated. Each question consisted of 3 parts (Georgetown University, 2006):

1. The minimum service level that respondents will accept,
2. The desired service level, and
3. The level of service that respondents perceive as being currently provided.

Clearly the first two parts of the questionnaire measure preferences, whereas the third part of the questionnaire measures perceptions. It should be noted that for managers and communications practitioners to make any useful communication interventions, knowledge about communication preferences have more practical relevance than having knowledge about perceptions, since perceptions are largely beyond the control of management and communication practitioners.

2.5.2 Proposition 3: Relationship between cultural biases and communication preferences

It is proposed that there is a relationship between the cultural characteristics of individuals working in a high-tech R&D organisation and their preferences for communication.

2.6 Conclusion of Literature Review

From the literature study that was conducted, it is concluded there is general consensus in the communication literature that organisational communication behaviour is dependent on the background, experiences and ultimately the world views of the individual employees. It is concluded that grid-group culture theory potentially offers a useful framework for reaching a better understanding of the relationship between the individual cultural biases (or world views) of employees and their communication behaviour within a high-tech corporate R&D organisation.

It is furthermore concluded that the communication literature is unclear about the distinction between communication perceptions and communication preferences, and that quantitative studies in the field of organisational

communication fail to clearly separate the dimensions of perception and preference.

In view of the literature study that was conducted, the following propositions are made:

2.6.1 Proposition 1: Predominant cultural bias

It is proposed that the cultural biases (or ways of life) of employees in a high-tech R&D environment be typed according to grid-group culture typology, and that the predominant cultural bias is that of *individualism*.

2.6.2 Proposition 2: Relationship between cultural biases and communication perceptions

It is proposed that there is a relationship between the cultural characteristics of individuals working in a high-tech R&D organisation and their perceptions of communication.

2.6.3 Proposition 3: Relationship between cultural biases and communication preferences

It is proposed that there is a relationship between the cultural characteristics of individuals working in a high-tech R&D organisation and their preferences for communication.

The following chapter describes the methodology which was followed to verify abovementioned research propositions.

3 RESEARCH METHODOLOGY

This chapter describes the methodology that was followed to address the research propositions which were put forward as solutions to the sub-problems outlined in paragraph 1.3.2. It begins by describing the research paradigm, followed by the research design, the data collection procedure and the statistical data analyses. Finally, the assumptions will be discussed, followed by a description of the validity and reliability applicable to this of the research study.

3.1 Research methodology / paradigm

In order to evaluate the propositions put forward for this study, a descriptive quantitative research approach is proposed. This research falls in the realm of positivism, since it does not involve any intervention or modification of the situation under investigation, and the research strategy will be designed to maintain objectivity as far as possible (Leedy & Ormrod, 2005). It is believed that the quantitative research approach is more appropriate than a qualitative approach for the following reasons (Leedy & Ormrod, 2005):

- The purpose is to test existing theory in a new environment, and not to build new theory or evaluate emergent theory. The existing theory of grid-group culture theory is applied in the communication environment. Although the application of grid-group culture theory in the communication environment had been proposed by Smallman and Weir (1999), no quantitative research study was performed to validate this proposal.

- A pre-determined model or framework is proposed for application to the research problem. The grid-group culture typology framework of Dake (1991, 1992) will be used to determine the cultural biases of the respondents.

- The variables are known for the proposed theory. The communication variables were identified from an extensive body of literature on organisational communications, as well as from an internal communication audit conducted within a R&D organisation (Sasol, 2007).

- There are established guidelines in the literature for evaluating the theory.

- The focus is very specific and not holistic. The specific dimensions of communication which are within the scope of this study are those of communication source, communication frequency, and communication channel.

- Data will be gathered and analysed statistically using validated instruments (to be discussed later).

- The researcher will maintain objectivity to avoid potentially biased and subjective conclusions. Objectivity is maintained by ensuring the requirements for validity and reliability are met, and through the application of accepted statistical procedures.

The research is a cross-sectional study (i.e. a cross-section in time), as it will not try to quantify long term behavioural changes as one would have in a longitudinal study (Leedy & Ormrod, 2005). Since the behavioural changes that were discussed in the literature survey often occur over an extended period of time, the researcher will only be able to discuss longer term behavioural changes in a qualitative manner when the data is analysed and interpreted.

The following ***assumptions*** are made with regards to the research methodology that will be followed:

- It is assumed that researcher bias can be minimised by adequate sampling techniques, a well designed questionnaire, avoidance of

researcher's generalisations, and the use of appropriate statistical techniques (Creswell, 2003; Leedy & Ormrod, 2005). It is assumed that these precautions will be adequate for preventing spurious effects.

- It is assumed that the open literature and historical information about the population that is researched provide adequate information about the variables that are required to consider in addressing the research problem, and that there are no unknown factors that could negate the validity of this study.

- It is assumed that adequate response on the questionnaire will be obtained so that an excessively large proportion of non-respondents will not cast doubt on the validity of the data for this quantitative research study (Leedy & Ormrod, 2005).

- For all quantitative statistical tests a significance level of 5% was assumed. The assumption of a 5% significance level is typical for the type of research performed in this study. Lower or higher significance values may lead to incorrect conclusions due to Type I or Type II errors (see Albright (2003) for a discussion).

3.2 Research Design

The descriptive statistics for this study will be derived from a survey consisting of a three-part self-report questionnaire. A survey research design is appropriate to the data collection process of this study, as it involves the asking and recording of questions to people in order to acquire information about their characteristics, opinions, attitudes, or previous experiences (Leedy & Ormrod, 2005). A correlational research design is appropriate to the statistical evaluation of the data that will be sampled (Leedy & Ormrod, 2005), since the differences in one characteristic or variable (i.e. cultural bias) are statistically related to differences in one or more other characteristics or variables (i.e. communication

perceptions and preferences). An important disadvantage of correlational research is that cause-and-effect relationships cannot be inferred on the basis of correlation alone (Leedy & Ormrod, 2005), therefore it cannot be argued that the adherence to any particular cultural bias is the cause of a particular communication preference or perception (or vice versa).

A disadvantage of survey research which is particularly relevant to this study is that it relies on self-report data (Leedy & Ormrod, 2005). Some of the implications of self-report data are (Leedy & Ormrod, 2005):

- that the respondents tell what they believe to be true,
- that the respondents tell what they think the appropriate answer should be,
- that responses may be affected by recent events, and
- that not all the questionnaires will be returned (i.e. low response rates are possible, creating the possibility of distorted data).

Another disadvantage of survey research is the fact that it captures a snap-shot in time. The implication is that when conclusions are generalised, the generalisation is an extrapolation to a longer time period, and at best this is a conjecture (Leedy & Ormrod, 2005). Although Leedy and Ormrod (2005) admits that extrapolation over time is the only way to make general conclusions from snap-shot data, the authors emphasise that there is nothing permanent but change, and that researchers should not assume that their conclusions are ever-abiding truths. The literature review on culture theory suggests that people's world views do change over time, while the literature review on communication suggests that communication behaviour can also change due to changes in the organisational environment (refer to Chapter 2). Therefore all conclusions from the current study are subject to the "snap-shot in time"

constraint, and should be confirmed by further studies to determine to what extent the correlations identified shift over the longer period.

Despite the disadvantages mentioned above, it is believed that the strength of the proposed methodology and research design is the advantage that researcher bias is minimised (see Section 3.1 above), and the advantage of maximising researcher objectivity through well defined guidelines (see Leedy & Ormrod (2005) for objectivity guidelines).

3.3 Population and sample

3.3.1 Population

The population for the current study includes all employees working in high-tech R&D organisations in South Africa.

3.3.2 Sample and sampling method

The type of sampling selected for this study, is that of non-probability convenient sampling. A sample was taken from the pool of employees working in the Sasol Technology Research and Development Division. It is believed that employees in this R&D organisation sufficiently represents the high-tech R&D community in South Africa, since this R&D organisation is the largest of its kind in South Africa, and has approximately 600 full time employees.

An electronic sampling method was selected for this study. The electronic questionnaire was distributed by email to all of the 600 employees in the selected R&D organisation. Of all the literature that was cited during the

literature review, none of the quantitative studies in the field of culture theory or communication yielded response rates below 20%, which implies that a worst-case expectation for response rate of 20% for the current study should give at least 120 data points. This is regarded as sufficient for purposes of this study, since Albright et al (2003) suggests that most analysts regard (as a rule of thumb) a sample size larger than 30 to be adequate for the central limit theorem to apply, unless the population distribution is very non-normal. Since the central limit theorem implies normality (Albright et al, 2003), the data have to be treated accordingly, ensuring that the statistical tools are used within their validity boundaries. Zander (2004) followed the same logic, and regarded a sample size of 66 as adequate for a similar quantitative statistical analysis.

3.4 The research instrument

The electronic self-report questionnaire used for this study is attached in Appendix A. The questionnaire consists of the following 3 parts:

Part 1: Demographics

Part 1 of the questionnaire is designed to obtain demographic data from the respondents. The demographic data that is regarded to be important and relevant to the current study are gender, age, post level (as indicator of social class within the organisation) and level of education (Marris et al, 1998). Marris et al (1998) also measured level of income, but for the current study level of income will be positively correlated with post level and therefore need not be measured. Noteworthy is the fact that race is not included as a demographic variable in culture typology studies (Hofstede (1980) describes the logic behind this). Two additional demographic variables are added to the present study, namely the time employed by the company and the first language of the respondent, as these variables may have a bearing on communication perceptions and communication behaviour. Gender and first language are

nominal categorical data, while age, post level, years employed and qualification are ordinal categorical data (Albright et al, 2003).

It should be noted that the relationship between demographic variables and grid-group culture variables is not an objective of this study, nor is the relationship between demographics and communication variables. However, sampling of demographic variables provides insight into the representativeness of the sample, and provides a more complete data set which can possibly be used in further studies beyond the scope of this particular research report.

Part 2: Cultural bias (culture typology)

As discussed under the literature review, the instrument devised by Dake (1991, 1992) and improved by Rippl (2002) will be used to measure the cultural biases of the grid-group culture typology. The validity of this instrument is discussed under Section 3.8. A number of statements are made for each of the cultural biases (or ways of life), and respondents have to score the statements on a 5-point Likert scale (giving ordinal categorical data) by marking either (1) Strongly disagree, (2) Disagree, (3) Don't agree or disagree, (4) Agree, or (5) Strongly agree. An individual's cultural bias is calculated by adding up the individual's responses to each of the items attributed to a specific cultural bias, and dividing it by the number of items used for that particular cultural bias. This results in a score between 1 and 5 for each cultural bias (or way of life) of each of the respondents, and an individual is characterised by his or her highest cultural bias score (Marris et al, 1998). The sub-parts of Part 2 in the questionnaire (see Appendix A) assess the following cultural biases:

Part 2.1: Hierarchism

Part 2.1: Egalitarianism

Part 2.3: Individualism

Part 2.4: Fatalism

Respondents who score low on all four dimensions may be classified as hermits, yet it should be noted that there are no specific questions for determining the cultural bias of hermits, and furthermore is there no specific guideline which exists for judging when the scores are “low enough” for a respondent to be characterised as a hermit.

A shortcoming of this research instrument is that previous studies showed that one unique cultural bias cannot always be measured or identified for each individual (see Palmer (1996) and Marris et al (1998)as examples). Rippl (2002) refers to this shortcoming as “sharing of ideological grounds” (Rippl, 2002:154), while Oltendal et al (2004:28) refers to this as “mixed adherences”. Marris et al (1998) found that only 20% of the respondents in their study had cultural bias cores above the mean score for the sample for only one unique cultural bias. Palmer (1996) used a slightly different criterion whereby the top 15% of respondents in each of the cultural bias groups were identified, and found that only 33% of respondents scored high in only one unique cultural bias group. In using this research instrument, the researcher runs the risk of obtaining responses which are not unique on only one single culture bias scale, and having to exclude such data from the statistical evaluation.

Another shortcoming of the grid-group culture typology instrument is the risk of sample bias towards egalitarians (Marris et al, 1998). Marris et al (1998) believe this bias is inherent to the original questionnaire developed by Dake (1991).

Both the sharing or ideological grounds (i.e. multiple cultural biases) and the sample bias towards egalitarians were addressed by Rippl (2002). Rippl suggested the use of an improved instrument, which is less prone to these shortcomings, and satisfies the requirements for validity (Rippl, 2002).

Therefore the improved questionnaire of Rippl (2002) was selected for the present study.

Part 3: Communication perception and preference

To obtain a measurement of the perception of communication, this study draws on climate and communication surveys and audits that were conducted inside the same R&D organisation (Business DNA, 2005; Yannakou, 2005; Sasol, 2005; Sasol, 2007), as well as various quantitative surveys in the open literature (see Chapter 2). The dimensions of communication perception that were reported to be of practical importance are those pertaining to communication frequency (Part 3.1), communication source (Part 3.2) and communication channel (Part 3.3). For each of these 3 communication dimensions (i.e. frequency, source and channel) respondents were asked to rate their experience (or perceptions) with communication about 10 of the most relevant topics for employees working in an organisational environment, namely:

1. How key critical challenges impact the employee's work environment,
2. How the employee's work environment fits into the broader Sasol Group strategy,
3. Sasol Technology's vision and mission,
4. The employee's work responsibilities,
5. How the employee's own performance will be measured,
6. What Sasol Technology's clients expect of R&D,
7. Policies, procedures and best practices,
8. Personal development and career paths in Sasol,
9. What the employee has to do to be promoted, and
10. Company initiatives to create a happier and healthier workforce.

To obtain a measurement of the preference of communication, the same 3 communication dimensions (i.e. frequency, source and channel) were used as were used for communication preference, as well as the same 10 topics most relevant to employees working in an organisational environment, with the difference being that employees were asked to rate their preference for frequency (Part 3.4), and to rank their preference for source and channel Parts 3.5 and 3.6 respectively).

A cover letter was included in the electronic questionnaire (see Appendix A). The cover letter included an explanation of the purpose of the research, a guarantee that the responses will be treated in a confidential manner, directives about whom the completed questionnaires should be submitted to, and a deadline for completion of the questionnaire, and contact details of the researcher and one HR person. The cover letter offered respondents the choice of submitting their responses electronically or by paper copy, and invited respondents to submit their responses either directly to the researcher or to the HR person in case they should be concerned about disclosing their identity.

The questionnaire was piloted by distributing it to 7 carefully selected employees who were willing to participate in the pilot survey. These employees were selected as follows:

1. The managing director was selected, since he had to give his approval for the distribution of the questionnaire (highest post level in R&D).
2. The researcher's line manager (middle management post level).
3. One person in the Human Resources Department.
4. Two sub-ordinates on the lowest post level (one engineer and one secretary).
5. One sub-ordinate on the second-lowest post level (below middle management).

By selecting respondents for the pilot study in abovementioned manner, it was ensured that feedback on the questionnaire was obtained from all employment levels. Virtually all the respondents (with the exception of one) indicated that the questionnaire is very long, and an effort was made to improve the questionnaire by making the statements as short and simple as possible. The request for rank order data in Parts 3.5 and 3.6 created some uncertainty, and rank order data was not always returned by the respondents (as was requested). As a solution to this problem, an example about the preference to receive the daily weather forecast was added to the questionnaire's answer tables.

3.5 Procedure for data collection

The questionnaire in Appendix A was distributed to the entire R&D Division of Sasol Technology via the internal electronic mail system. Four weeks were allowed for completion of the questionnaire, where after a reminder was sent to all the non-respondents, urging them to please respond to the survey, and allowing an extra 2 weeks for completion of the survey.

The data from all completed surveys were punched into an excel workbook, to be used as input to the further statistical evaluation.

3.6 Data analysis and interpretation

The data obtained through the questionnaire in Appendix A were analysed by various statistical techniques in order to establish if the cultural biases of respondents are statistically independent of their communication perceptions and preferences. Since the different types of data that were sampled require

different statistical techniques, each of the data types will now be discussed separately.

3.6.1 Analysis of grid-group culture data (Part 2)

The improved questionnaire of Rippl (2002) yielded ordinal categorical data from a 5-point Likert scale. Although rescaling would normally be required due to the fact that the Likert scale data do not provide interval measures that explain how much the variables differ from one another (Leedy & Ormrod, 2005; Zander, 2004), this approach was not followed because the grid-group typology instrument is a standard instrument from the open literature, and the instrument was applied according to the fairly simple scoring rules described in the literature. The scoring procedure entails the calculation of a weighted average for each of the cultural bias groups (i.e. individualism, egalitarianism, hierarchism, and fatalism), and assigning that particular cultural bias to the respondent for which the highest score was obtained. For respondents that scored high in more than one cultural bias group, cultural bias was assigned according to the most extreme score (Palmer, 1996). However, cultural bias scores were considered to be equal if their average values differed by less than 5%, in which case the data obtained from such respondent was excluded from the statistical analysis because such respondent adhered to more than one cultural bias.

3.6.2 Analysis of communication frequency (Questions 3.1 & 3.4)

A series of 1-way ANOVA tests are proposed in order to analyse if cultural biases independent of the perception of communication frequency (Questions 3.1.1 to 3.1.10) or of the preference for communication frequency (Questions 3.4.1 to 3.4.10). In performing the statistical analyses on perceptions and preferences for communication frequency, the frequencies were treated as continuous numerical variables because frequency is time dependant, and time

has a continuous scale which allows meaningful arithmetic to be performed on it (Albright et al, 2003).

One 1-way ANOVA test was performed for each of the questions. The 1-way ANOVA test was used to check if the means of the communication frequencies for each of the cultural biases are significantly different from one another or not (Albright et al, 2003). The hypothesis test for the 1-way ANOVA test is as follows (assuming a 5% significance level)

Accept H_0: All means are equal (p-value > 0.05).

Accept H_A: At least one mean is different from the rest (p-value < 0.05).

The 1-way ANOVA test is based on two assumptions, namely (1) the population variances are equal to some common variance, and (2) the populations are normally distributed (Albright et al, 2003). In order to satisfy the latter assumption, a log transformation of the ordinal categorical data for communication rate had to be performed. The rates were calculated on an annual basis before it was log transformed:

Once per week	=	52 times per year
Once per month	=	12 times per year
Once every 3 months	=	4 times per year
Once every 6 months	=	2 times per year
Once per year	=	1 time per year
Less than a year	=	0 times per year

Tables of frequency counts were set up for each of the questions, indicating the number of counts for each of the cultural biases in each of the log(rate) categories. Then, for each cultural bias groups, the mean and standard deviation of the log(rate) communication frequencies were calculated so that the

normal distribution with this mean and standard deviation represented the measured counts as closely as possible. The χ^2 statistic was used as a measure for closeness of fit, and the values for the mean and standard deviation were determined using the Excel solver regression algorithm. This approach is an adaptation of the distribution fitting algorithm proposed by Stacey (2005), and an example is shown in Appendix B. The procedure was repeated for each of the cultural biases for each of the questions, and finally one 1-way ANOVA analysis was done for each of the questions (i.e. Questions 3.1.1 to 3.1.10 and Questions 3.4.1 to 4.4.10). Details for the calculation of the 1-way ANOVA test can be found in Albright et al (2003) and Montgomery (2001), and an example is shown in Appendix C. It should be noted that additional tests to ensure normality (a requirement for the 1-way ANOVA test) are not required, since the requirement for normality is implied because of the distribution-fitting approach that was followed.

3.6.3 Analysis of the perception of communication source and channel (Questions 3.2 & 3.3)

The χ^2 test for independence (Albright el al, 2003) was used to determine if the cultural biases are independent of the perception of communication source (Questions 3.2.1 to 3.2.10), and also for determining if the cultural biases are independent of the perception of communication channel (Questions 3.3.1 to 3.3.10). The χ^2 test for independence is based on counts in a contingency (or frequency) table, and tests if counts in the row categories are probabilistically independent of the counts in the column categories. A significance level of 5% was used, and the hypothesis test is as follows:

Accept H_0: The row categories (cultural biases) and column categories (communication source or channel) are independent (p-value > 0.05).

Accept H_A: The row categories (cultural biases) and column categories (communication source or channel) are NOT independent (p-value < 0.05).

An example calculation of a χ^2 test for independence is shown in Appendix D.

3.6.4 Analysis of the preference for communication source and channel (Questions 3.5 & 3.6)

A series of 2-way ANOVA tests (Montgomery, 2001) are proposed in order to analyse if cultural biases are independent of the preferences for communication source (Questions 3.5.1 to 3.5.10), or of the preferences for communication channel (Questions 3.6.1 to 3.6.10). Since the respondents were asked to rank their preferences according to a 5-point preference scale, ordinal categorical response data was obtained for these questions. These scales are limited in the sense that they do not provide interval measures that explain how much the variables differ from one another (Leedy & Ormrod, 2005; Zander, 2004), and therefore rescaling is required. The requirement for rescaling is considered necessary since evidence exists in the literature suggesting that the treatment of ordinal categorical data as interval data may produce flawed results (Stacey, 2005).

Two options for rescaling of ordinal level response data exist, namely correspondence analysis (as proposed by Bendixen and Sandler, 1995), or the application of a distribution-fitting algorithm (as proposed by Stacey, 2005). In a thorough comparative study by Stacey (2005) it was shown that the distribution fitting approach have accuracy and validity which is superior to the approach of using ordinal level data as interval data without rescaling, or if rescaling is done using correspondence analysis. Therefore the distribution fitting algorithm was selected for rescaling the data of the present study.

A detailed discussion of the distribution fitting algorithm can be found in the paper by Stacey (2005). In short, the distribution-fitting approach estimates the values of the means and standard deviations of the distributions of the underlying attributes (using normal or log-normal distributions), and also estimates the attitudinal thresholds that would result in the best fit for the observed categorical responses (Stacey, 2005). The distribution-fitting algorithm involves the calculation of the expected frequencies from the normal (or log-normal) distribution function (using arbitrary selected values for the means and standard deviation), followed by the calculation of the χ^2 statistic as indicator of how close the expected frequencies are to the actual measured frequencies. By using the Excel solver regression algorithm, the χ^2 statistic can be minimised by searching for the optimum values of the mean, standard deviation and attitudinal threshold values. The rescaling is done so that a mean value of zero is obtained for each of the attitudinal responses for each of the cultural bias groups. A macro-driven spreadsheet developed by Stacey (2005) was used for the distribution-fitting calculations in the present study.

For each of the questions on the preferences for communication source (Questions 3.5.1 to 3.5.10) and for each of the questions on the preferences for communication channel (Questions 3.6.1 to 3.6.10), the distribution fitting algorithm had to be run once for each of the cultural biases to be included in the 2-way ANOVA analysis. For each of the 5 possible communication sources or channels, frequency tables were set up to reflect the counts which a particular cultural bias scored for each of the 5 ranks. After converting the frequency data to proportions, the data was used as input to the distribution fitting algorithm. An example of the inputs and outputs of the distribution fitting algorithm is shown in Appendix E.

The output of the distribution fitting algorithm gave (for each of the cultural biases in each of the questions) the means, standard deviations, and the rescaled rankings (also called attitudinal thresholds). This data was used as

input to the 2-way ANOVA calculation. The calculation procedure of Montgomery (2001) for unbalanced proportional data was followed for the 2-way ANOVA calculation (Montgomery, 2001:601), and an example is shown in Appendix F. Each 2-way ANOVA test (i.e. one for each of questions 3.5.1 to 3.5.10 and 3.6.1 to 3.6.10) produced three p-values which have to be checked for significance. The three hypothesis tests are performed for each of the 2-way ANOVA tests according to a 5% significance level:

Accept $H1_0$: Over all the categories for preference of communication source (or channel), the cultural biases are independent (p1-value > 0.05).

Accept $H1_A$: Over all the categories for preference of communication source (or channel), the cultural biases are NOT independent (p1-value < 0.05).

Since all respondents were forced to allocate (rank) all 5 scores (one for each preference of source or channel), the mean value for each respondent on the preference scale is always 3, regardless of the respondent's cultural bias, and therefore a p1-value of 1 will always be obtained for H1, indicating no significance for cultural bias if considered on its own (without interaction). Strictly speaking this statement about the mean value of 3 is not entirely correct due to the rescaling procedure that was followed, yet it will be shown that a p1-value of 1 was obtained for all hypothesis tests performed in this study.

Accept $H2_0$: Over all the categories for cultural biases, the preferences for communication source (or channel), are independent (p2-value > 0.05)

Accept $H2_A$: Over all the categories for cultural biases, the preferences for communication source (or channel), are NOT independent (p2-value < 0.05)

Accept $H3_0$: In each of the categories for the preference for communication source (or channel), all the cultural biases are independent, and therefore the preferences of the different cultural biases are not significantly different from one another (p3-value > 0.05).

Accept $H3_A$: In each of the categories for the preferences for communication source (or channel), the cultural biases are NOT independent, and at least one cultural bias has a preference which is significantly different from the rest (p3-value < 0.05).

In order to test the Propositions 2 and 3 of this study, the third hypothesis test is of importance. However, the second hypothesis test also gives valuable insights into the general preferences for communication source and channel, should it become apparent that there is not a great influence of cultural bias (i.e. if $H3_0$ is accepted, check for the acceptance of $H2_A$ for the general communication preferences for source and channel).

It should be noted that additional tests to ensure normality (a requirement for the 2-way ANOVA test) are not required, since the requirement for normality is implied because of the distribution-fitting approach that was followed.

3.7 Limitations and potential weaknesses of the study

Limitations and potential weaknesses pertaining to the present study include the following:

1. The statistical techniques used in this study are limited to the requirement that the data are normally distributed, and the data have to be treated accordingly.

2. Data for the cultural biases of respondents are limited to nominal categorical data, which implies that in order to be part of the statistical analyses, each respondent is allowed to adhere to only one cultural bias. Data for respondents that scored equally high in more than one cultural bias group, were ignored in the statistical analysis.

3. A potential weakness is the fact that the survey was restricted to only one R&D organisation, which places a restriction on the more general external validity of results and conclusions from this study.

4. The risk of sample bias towards egalitarians is a potential weakness of the grid-group culture typology. For this reason the improved instrument proposed by Rippl (2002) was used, as it it claimed to satisfy the requirements for validity and reliability.

3.8 Validity and reliability

3.8.1 External validity

External validity refers to the extent to which the results and conclusion from this study can be generalised and applied to environments beyond the scope of the current study (Leedy & Ormrod, 2005). Although this study is confined to sampling within a single R&D organisation in South Africa, external validity with regards to other R&D corporate organisations is claimed by virtue of the fact that it is a real-life setting, (Leedy & Ormrod, 2005), and that a representative sample will be taken (Leedy & Ormrod, 2005) from one of the two largest corporate R&D organisations in South Africa. Replication in other large R&D organisations would have been ideal, but falls outside the scope of the current investigation.

3.8.2 Internal validity

Internal validity refers to the extent to which the research methodology and the results that are obtained allow accurate conclusions about the relationships within the data (Leedy & Ormrod, 2005). The possibility must be reduced that the results that are obtained could be explained by to factors or reasons that were not included in the present study.

The validity of the grid-group culture typology has been applied extensively by numerous researchers, but many of the research efforts can be criticised for the lack of testing for internal validity (Rippl, 2002). Rippl (2002) in fact addressed two controversial questions, namely (1) whether the culture typology concept as proposed by Douglas and Wildavsky (see literature review) can be tested on the basis of individual-level data (since it is often argued that culture is a group behavioural phenomenon), and (2) whether the instrument devised by Dake (1991, 1992) shows sufficient construct validity. The concept of construct validity means that the measurement instrument should be designed in a way that it supports the underlying theory, for example that a negative correlation between individualism and hierarchy is to be expected. Marris et al (1998) also found Dake's measuring instrument problematic for similar reasons. Rippl (2002) put forward seven hypotheses of how the cultural bias constructs should theoretically be correlated, and showed that the central assumptions of the measurement theory as put forward by Dake's published instrument are inadequate to measure the constructs of culture theory (for example hierarchy and individualism was found to be positively correlated and therefore contradicts the underlying theory). Rippl (2002) built on Dake's work and devised an improved measuring instrument for which construct validity was proven by structural equation modelling and confirmatory factor analysis. Although this instrument does not directly measure culture, Rippl (2002) provided adequate motivation that individual-level data obtained with the improved measuring instrument is an adequate indirect measure of the underlying process connected to culture, and proved that it is possible to measurement cultural biases which conform to the underlying theory. More recently Oltendal et al (2004) made

further improvements to Dake's grid-group theory measuring instrument by adding a number of questions related to language and communication. Although these questions are aimed at the Norwegian transport industry, but the questions are generic enough to be adapted to other environments. The questions were framed "to investigate the symbolic exchange in a more general sense" (Oltendal et al, 2004: 33).

Based on the discussion above, it is believed that the existing instrument for measuring grip-group culture typology, if coupled to appropriate statistical techniques to determine the relationships between variables, provides adequate internal validity to the current research study. The technique of triangulation will be used to further support internal validity (Leedy & Ormrod, 2005), which involves the use of multiple sources of information to support observations, results and conclusions. The collection and statistical analysis of new data from the primary source of information, and this will be supported by prior studies in related fields (literature study), and the results from communication surveys, climate surveys and other historical data available inside the company containing the same population as is studied in the current investigation (Buniness DNA, 2005; Yannakou, 2005; Sasol, 2005).

3.8.3 Reliability

Reliability refers to the consistency with which the proposed measuring instrument will give a certain result when the entity or characteristic that is measured has not changed (Leedy & Ormrod, 2005). For the present study it is important to achieve internal consistency reliability, which is the extent to which the items within a single instrument yield similar results (Leedy & Ormrod, 2005). By example, all questions in the measuring instrument aimed at measuring individualism should consistently have high scores if an individualist is evaluated. Cronbach's alpha coefficient (Cronbach, 1951) is a popular way for calculating internal consistency for the different clusters of cultural biases (or

ways of life) (Marris et al, 1998; Rippl, 2002), and this approach is proposed for the present study. The Spearman-Brown, Kuder-Richardson and split-halves tests are alternatives to the Cronbach alpha reliability tests (De Wet et al, 1981). The various tests for internal consistency reliability were calculated using the reliability calculator of Siegle (2008), and the correctness of this calculator was verified using the equations published by De Wet et al (1981) for the Kuder-Richardson test, and the Statistica software package for the Cronbach alpha test.

4 PRESENTATION OF RESULTS

4.1 Introduction

The results from this study are discussed next, starting with the response rate that was obtained and the demographic profile of the respondents. This is followed by the presentation of the results pertaining to Propositions 1, 2 and 3.

4.2 Response rate

Out of the 600 people in the R&D organisation to whom the questionnaire was distributed, 86 people (or 14.3%) returned responses upon the first request. After a reminder was sent and the survey was extended for two weeks, another 48 completed questionnaires were returned, which brought the total number of responses to 134 (a response rate of 22.3%). This is regarded as sufficient for the present study (refer to Section 3.3.2 for motivation).

4.3 Demographic profile of respondents

In order to characterise the sample, the demographic profile is reported below. Since the demographic data does not form part of the statistical evaluation for this study, the demographic variables were not coded.

Gender

Table 1 below indicates the number of male versus female responses. It is interesting to observe that the ratio between male and female respondents is almost identical to the ratio which was obtained by Zander (2004) who also conducted a survey in the corporate environment in South Africa.

Table 1: Response rates according to gender

Responses	# of Responses	% of Responses
Male	103	76.9
Female	31	23.1
Totals	**134**	**100**

Age

The ages if the respondents were found to vary from 19 years to 61 years. Figure 3 below indicates how the ages of the respondents are distributed.

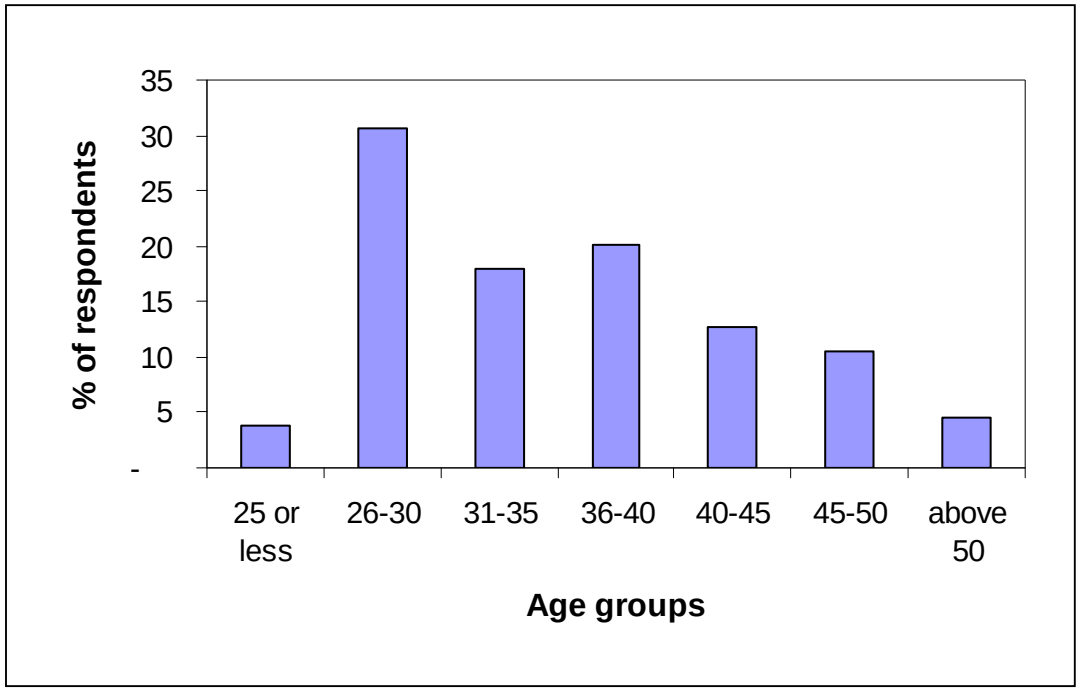


Figure 3: Response rates according to age

Employment level

The employment levels in the organisation that was sampled, range from Level 2 (highest level, that of the Managing Director) to Level 7 (lowest employment level). The response rates of the different employment levels are shown in Figure 4 below. From the data presented in Figure 4, it appears that an unrealistically low response rate was obtained from the employees on the lower level of the organisation.

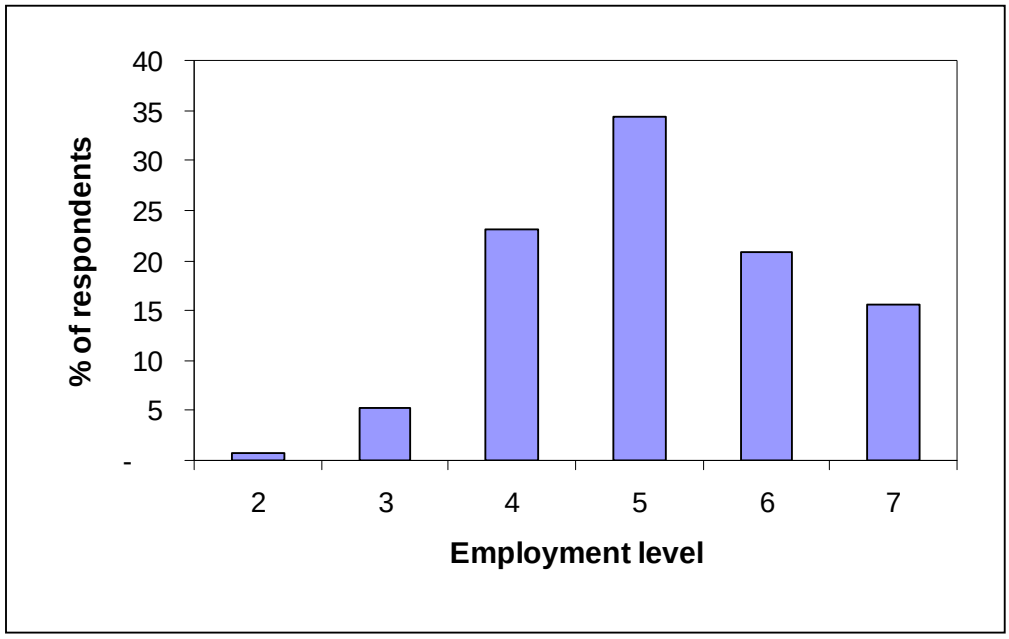


Figure 4: Response rates according to employment level

Qualification level

Respondents were asked to indicate their highest qualification level, and the response rates are shown in Figure 5 below. It can be seen that 89.6% of the respondents have tertiary qualifications, indicating that most of the respondents can be classified as “knowledge workers”.

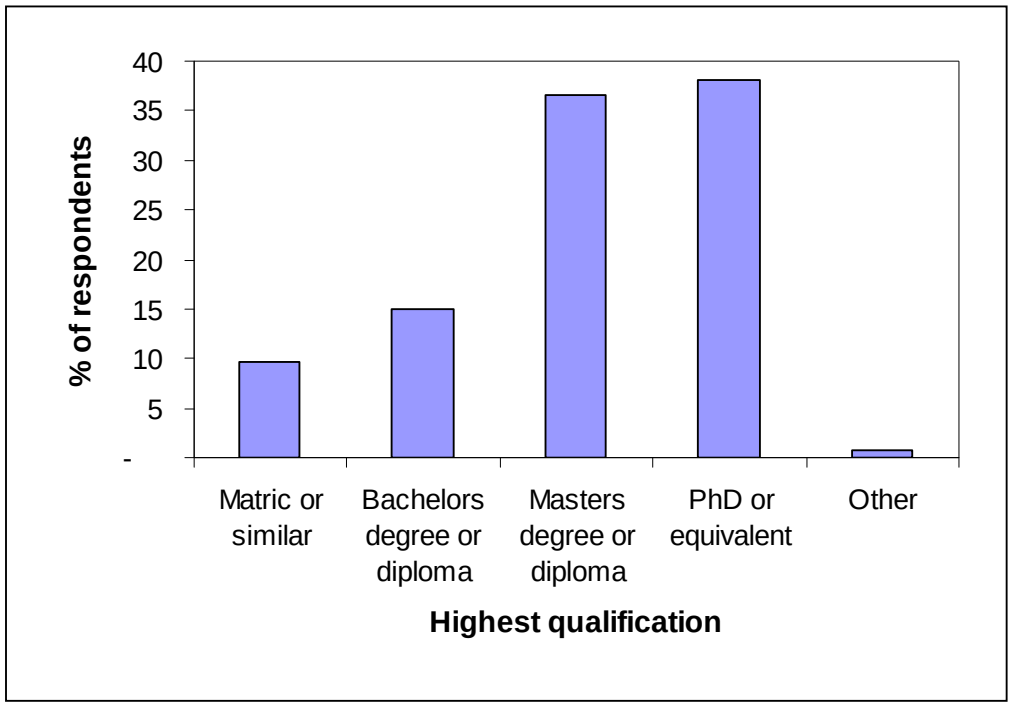


Figure 5: Response rates according to qualification level

Years of service

A summary of the years of service of the respondents are shown in Figure 6 below. It can be seen that two thirds of the employees are in the service of the company for 10 years or less, and only one third of the employees have a service history that exceeds 10 years.

Home language

A summary of the home language of the respondents are shown in Figure 7 below. Since the organisation has a larger proportion of employees belonging to black ethic groups, it appears that the black African groups were reluctant to take part in this survey.

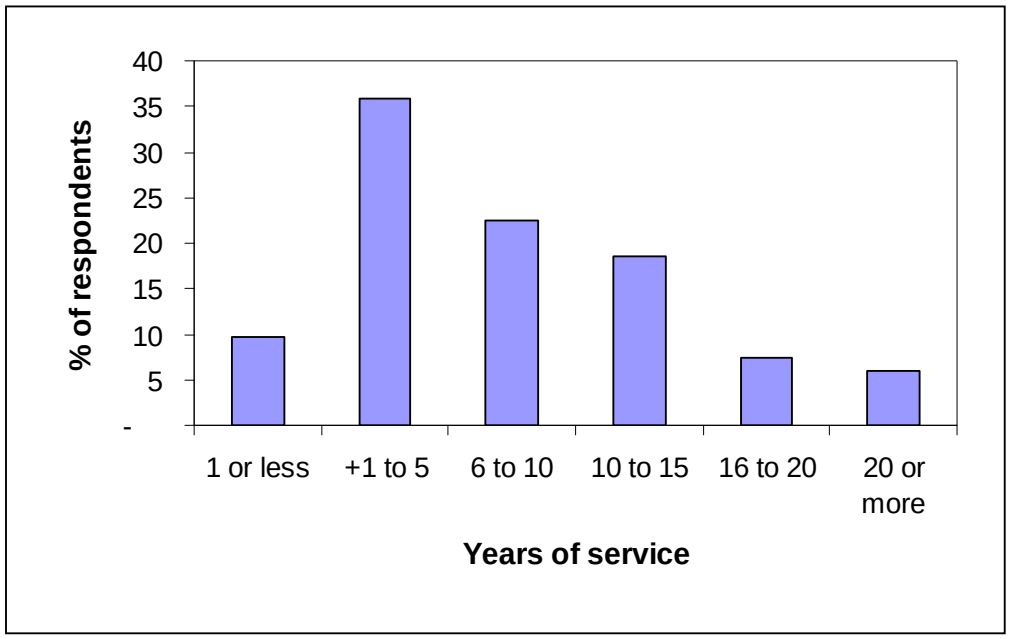


Figure 6: Response rates according to years of service

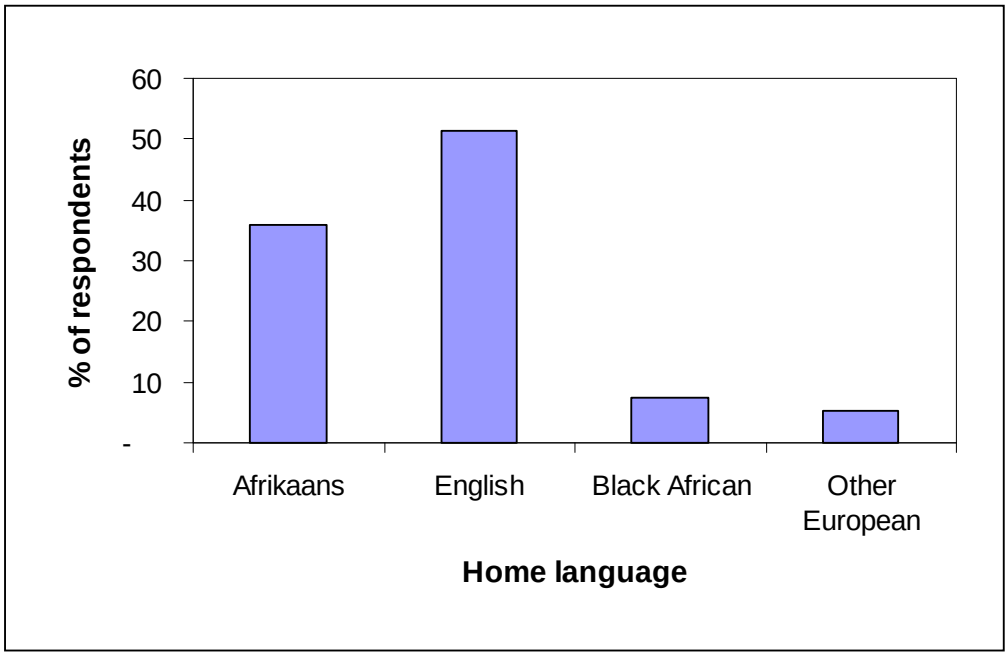


Figure 7: Response rates according to home language

4.4 Results pertaining to the predominant cultural bias

In this section, the results pertaining to the grid-group culture typology will be presented. It should be noted that the questions in the improved grid-group culture typology questionnaire of Rippl (2002) were used in the statistical evaluation (this excludes some of the questions initially proposed by Dake (1991, 1992)).

4.4.1 Summary of the cultural bias profile of the sample

A summary of the cultural bias profile of the sample is shown in Figure 8 below. The respondents were assigned to a particular cultural bias according to their highest scores is each of the four possible cultural bias groups, except for instances where the respondents' cultural bias scores differed by less than 5%, in which case the scores were regarded as equal, and the respondent was subsequently assigned to the group named "Other" in Figure 8. For purposes of comparison the data obtained by Marris et al (1998) and Palmer (1996) are also presented in Figure 8. Marris et al (1998) also considered only these three cultural biases in their quantitative study. Unfortunately the percentage of fatalists and multiple cultural biases were not reported by Palmer (1996) .

It should be noted that a very small percentage of respondents are fatalists. Since the number of fatalists in the sample was so small, the fatalist cultural bias could not be included in further statistical evaluations. All further statistical tests were thus conducted for only three cultural biases (i.e. hierarchists, individualists and egalitarians).

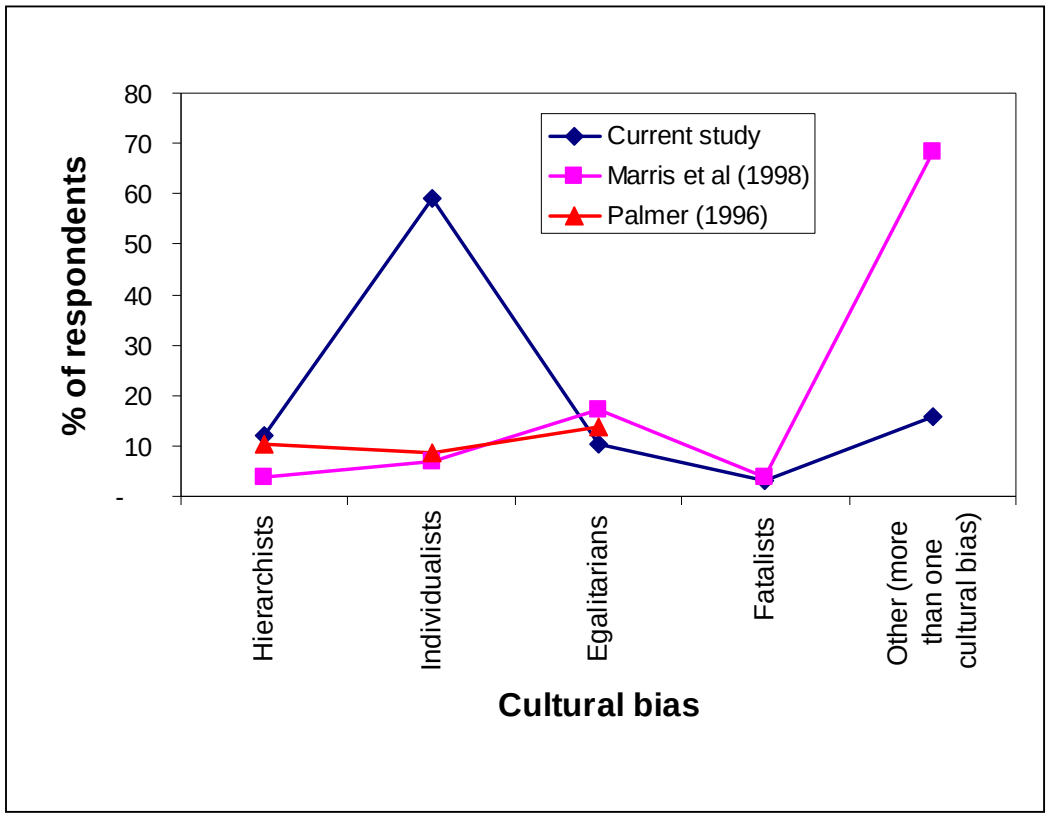


Figure 8: Cultural bias profile of the sample

4.4.2 Internal reliability of the grid-group culture typology questionnaire

The internal reliability of the grid-group culture typology questionnaire was verified by calculating the Cronbach alpha coefficients (Cronbach, 1951) for each of the groups of questions for a particular cultural bias group. The Cronbach alpha coefficients for each of the cultural biases are shown in Table 2 below, as well as the Cronbach alpha coefficients obtained by Marris et al (1998) and Palmer (1996). From Table 2 it can be seen that all the Cronbach alpha coefficients for this study have values exceeding 0.60, which indicate an acceptable level of internal reliability.

Table 2: Cronbach alpha coefficients – Test for internal reliability of cultural bias questions

Cultural bias	Cronbach alpha coefficients (this study)	Cronbach alpha coefficients (Marris et al, 1998)	Cronbach alpha coefficients (Palmer, 1996)
Hierarchists	0.731	0.57	0.58
Individualists	0.652	0.72	0.60
Egalitarians	0.705	0.63	0.62
Fatalists	0.745	0.73	Not reported

4.4.3 Conclusion pertaining to the predominant cultural bias

From Figure 8 it is evident that 59% of the employees who participated in the survey, are individualists. This gives overwhelming support to Proposition 1, which proposed that the cultural biases (or ways of life) of employees in a high-tech R&D environment are predominantly individualists according to grid-group culture typology.

4.5 Results pertaining to the relationship between cultural biases and communication perceptions

In this section, the results pertaining to the relationship between cultural biases of employees in a R&D organisation and their communication perceptions will be presented. The dimensions of communication that will be evaluated are those of communication frequency, communication source, and communication channel.

4.5.1 Tests for evaluating the relationship between cultural biases and the perceptions of communication frequency

As discussed in Section 3.6, a series of 1-way ANOVA tests (1 per question) were used to evaluate if the cultural biases of respondents are independent of their perceptions of communication frequency. The statistical results are presented in Table 3 below. The comment "Independent" implies that there is no evidence that the cultural biases of respondents are in any way related to their perception of communication frequency for that particular aspect of communication indicated by the question number

Table 3: Results of 1-way ANOVA tests for evaluating the relationship between cultural biases and the perceptions of communication frequency

Question number	p-value	Comment
3.6.1. How key critical challenges impact my work environment	0.711	Independent
3.6.2. How my work environment fits into the broader Sasol Group strategy	0.920	Independent
3.6.3. Sasol Technology's vision and mission	0.154	Independent
3.6.4. My work responsibilities	0.718	Independent
3.6.5. How my own performance will be measured	0.985	Independent
3.6.6. What Sasol Technology's clients expect of R&D	0.477	Independent
3.6.7. Policies, procedures and best practices	0.893	Independent
3.6.8. Personal development and career paths in Sasol	0.579	Independent
3.6.9. What I have to do to be promoted	0.164	Independent
3.6.10. Company initiatives to create a happier and healthier workforce	0.895	Independent

4.5.2 Tests for evaluating the relationship between cultural biases and the perceptions of communication source

As discussed in Section 3.6, a series of χ^2 tests for independence (1 per question) were used to evaluate the relationship between the cultural biases of respondents and their perceptions of communication source. The statistical results are presented in Table 4 below. The comment "Independent" implies that there is no evidence that the cultural biases of respondents are in any way related to their perceptions of communication source for that particular aspect of communication indicated by the question number. Only one question indicates a significant relationship, i.e. Question 3.2.1, which relates to knowledge about the requirements for promotion. All three cultural biases (indicated by "H" for hierarchists, "I" for individualists, and "E" for egalitarians) have a perception that they get information about promotion requirements primarily from Line Management. The percentages indicated in Table 4 indicate what percentage of a particular cultural bias group perceive to be getting information about performance requirements from Line Management (for example 56.1% of all individualists have a perception that they get information about promotion requirements from Line Management). These culture group proportions, as well as those for all the other communication sources, are shown graphically in Figure 9.

Table 4: Results of χ^2 tests for independence for evaluating the relationship between cultural biases and the perceptions of communication source

Question number	p-value	Comment
3.2.1. How key critical challenges impact my work environment	0.940	Independent
3.2.2. How my work environment fits into the broader Sasol Group strategy	0.864	Independent
3.2.3. Sasol Technology's vision and mission	0.155	Independent
3.2.4. My work responsibilities	0.754	Independent
3.2.5. How my own performance will be measured	0.667	Independent
3.2.6. What Sasol Technology's clients expect of R&D	0.581	Independent
3.2.7. Policies, procedures and best practices	0.347	Independent
3.2.8. Personal development and career paths in Sasol	0.774	Independent
3.2.9. What I have to do to be promoted	0.040	Not independent H, I, E high for Line Management H = 44.0% I = 56.1% E = 70.0%
3.2.10. Company initiatives to create a happier and healthier workforce	0.934	Independent

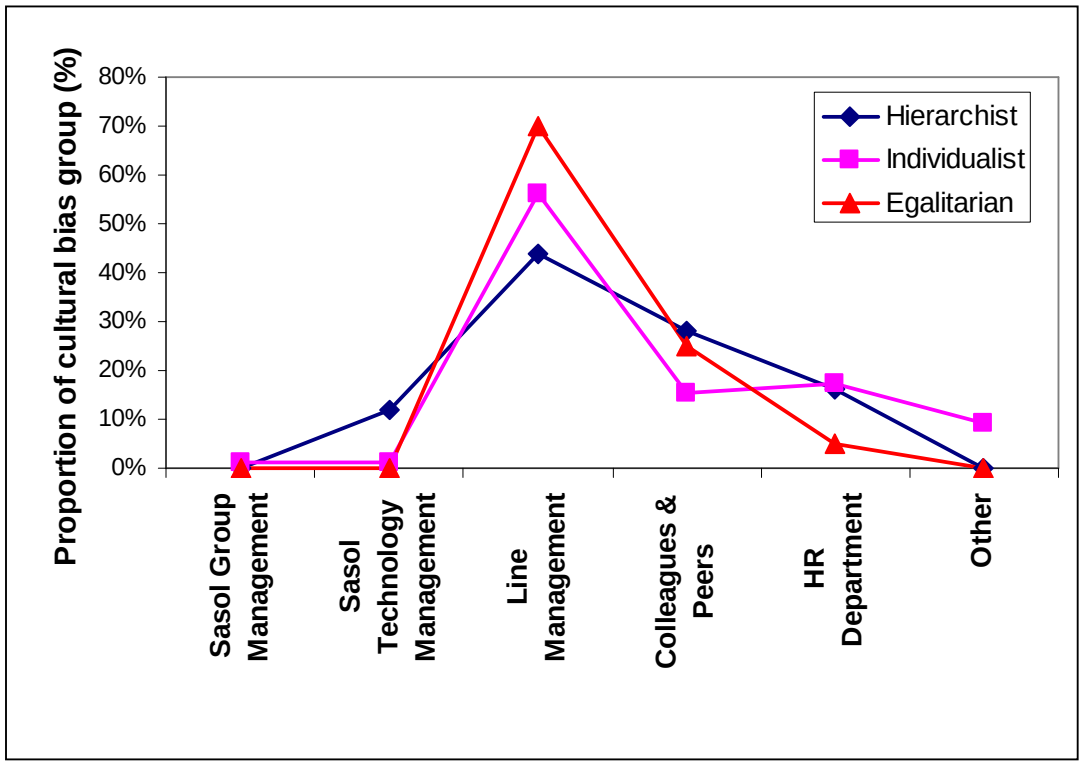


Figure 9: Proportions of each cultural bias group perceiving what their communication sources are for promotion requirements (Q 3.2.9)

4.5.3 Tests for evaluating the relationship between cultural biases and the perceptions of communication channel

As discussed in Section 3.6, a series of χ^2 tests for independence (1 per question) were used to evaluate the relationship between the cultural biases of respondents and their perceptions of communication channel. The statistical results are presented in Table 5 below. The comment "Independent" implies that there is no evidence that the cultural biases of respondents are in any way related to their perception of communication channel for that particular aspect of communication indicated by the question number.

Table 5: Results of χ^2 tests for independence for evaluating the relationship between cultural biases and the perceptions of communication channel

Question number	p-value	Comment
3.3.1. How key critical challenges impact my work environment	0.872	Independent
3.3.2. How my work environment fits into the broader Sasol Group strategy	0.861	Independent
3.3.3. Sasol Technology's vision and mission	0.992	Independent
3.3.4. My work responsibilities	0.770	Independent
3.3.5. How my own performance will be measured	0.905	Independent
3.3.6. What Sasol Technology's clients expect of R&D	0.438	Independent
3.3.7. Policies, procedures and best practices	0.500	Independent
3.3.8. Personal development and career paths in Sasol	0.750	Independent
3.3.9. What I have to do to be promoted	0.817	Independent
3.3.10. Company initiatives to create a happier and healthier workforce	0.791	Independent

4.5.4 Internal reliability of the questionnaire for perceptions of communication

The internal reliability of the questionnaire with regards to the questions on communication perceptions were verified by calculating the Cronbach alpha coefficients (Cronbach, 1951) for each of the groups of questions for communication perceptions. The Cronbach alpha coefficients for each of the groups of questions are shown in Table 6 below. It can be seen that all the Chronbach alpha coefficients for this study have values exceeding 0.60, which indicate an acceptable level of internal reliability.

Table 6: Cronbach alpha coefficients – Tests for internal reliability of questions on communication preferences

Groups of questions	Cronbach alpha coefficient
Frequency of communication	0.842
Sources of communication	0.602
Channels of communication	0.705

4.5.5 Conclusion pertaining to the relationship between cultural biases and communication perceptions

From the statistical results presented in Tables 3, 4 and 5, it is concluded that the cultural characteristics of individuals that were sampled are independent of their perceptions of communication frequency, source and channel. Only one exception to this general conclusion was found, namely that all three cultural biases (i.e. hierarchists, individualists and egalitarians) have a perception that they get information about promotion requirements primarily from Line Management.

4.6 Results pertaining to the relationship between cultural biases and communication preferences

In this section, the results pertaining to the relationship between cultural biases and communication preference will be presented. The dimensions of communication that will be evaluated are those of communication frequency, communication source, and communication channel.

4.6.1 Tests for evaluating the relationship between cultural biases and preferences for communication frequency

As discussed in Section 3.6, a series of 1-way ANOVA tests (1 per question) were used to evaluate the relationship between the cultural biases of respondents and their preferences for communication frequency. The statistical results are presented in Table 7 below. The comment "Independent" implies that there is no evidence that the cultural biases of respondents are in any way related to their preference for communication frequency for that particular aspect of communication indicated by the question number. Only one communication topic (i.e. Question 3.4.7 relating to policies, procedures and best practices) indicated that the cultural biases are not independent of the preferences for communication frequency, and the preferred communication frequencies are shown in Table 7. A graphic representation of the means and standard deviations for the log-transformed communication rate preferences pertaining to policies, procedures and best practices (i.e. Question 3.4.7), is shown in Figure 10.

Table 7: Results of 1-way ANOVA tests for evaluating the relationship between cultural biases and preferences for communication frequency

Question number	p-value	Comment
3.4.1. How key critical challenges impact my work environment	0.315	Independent
3.4.2. How my work environment fits into the broader Sasol Group strategy	0.665	Independent
3.4.3. Sasol Technology's vision and mission	0.110	Independent
3.4.4. My work responsibilities	0.866	Independent
3.4.5. How my own performance will be measured	0.145	Independent
3.4.6. What Sasol Technology's clients expect of R&D	0.528	Independent
3.4.7. Policies, procedures and best practices	0.005*	Not independent H = 9.7 per year I = 3.5 per year E = 7.4 per year
3.4.8. Personal development and career paths in Sasol	0.822	Independent
3.4.9. What I have to do to be promoted	0.363	Independent
3.4.10. Company initiatives to create a happier and healthier workforce	0.281	Independent

* Significant at the 5% significance level

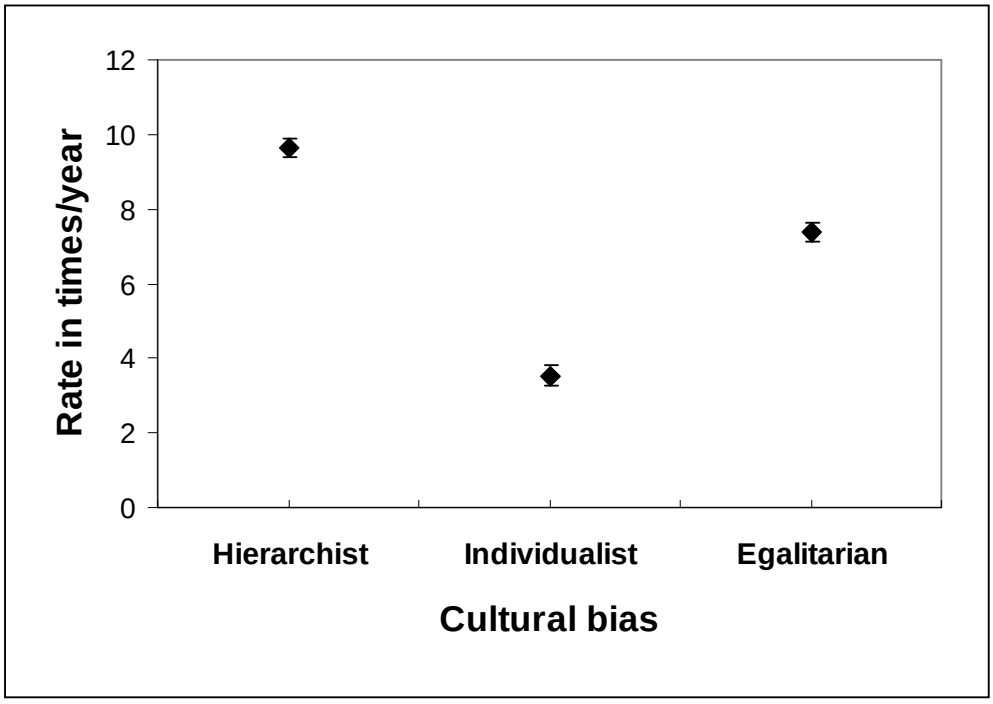


Figure 10: Cultural bias preferences for communication frequency pertaining to policies, procedures and best practices (Q 3.4.7)

4.6.2 Tests for evaluating the relationship between cultural biases and preferences for communication source

As discussed in Section 3.6, a series of 2-way ANOVA tests (1 per question) were used to evaluate the relationship between the cultural biases of respondents and their preferences for communication source. The statistical results are presented in Table 8 below. From the p2-values in Table 8 it can be seen that the differences in preferences for communication sources (for all cultural biases combined) are statistically significant for all 10 communication topics that were evaluated. The p3-values indicate that interactions exist between cultural biases and the preference for communication sources for two of the communication topics, namely that pertaining to work responsibilities (Question 3.5.4), and that pertaining to policies, procedures and best practices (Question 3.5.7). Figures 11 to 20 show how the preferences for communication source vary for the different cultural bias groups.

Table 8: Results of 2-way ANOVA tests for evaluating the relationship between cultural biases and preferences for communication source

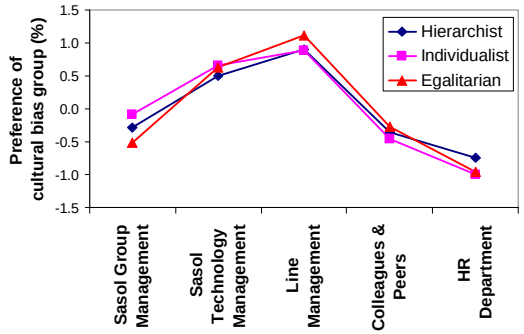
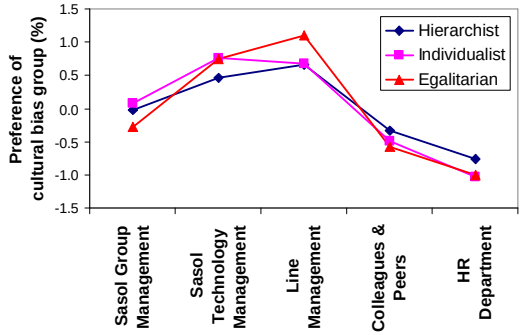
Question number	p-values	Comment	Graphs of communication preferences
3.5.1. How key critical challenges impact my work environment	p1 = 1.000	No significant difference for cultural biases	 **Figure 11: Preferences for communication source pertaining to key critical challenges impacting the work environment**
	p2 = 0.000	Significant differences for source preferences. 1st preference: Line Management 2nd preference: Sasol Technology Management Lowest preference: HR Department	
	p3 = 0.356	No interaction of cultural biases with sources of communication	
3.5.2. How my work environment fits into the broader Sasol Group strategy	p1 = 1.000	No significant difference for cultural biases	 **Figure 12: Preferences for communication source pertaining to how work environment fits into the broader Sasol Group Strategy**
	p2 = 0.000	Significant differences for source preferences. 1st preference: Line Management 2nd preference: Sasol Technology Management Lowest preference: HR Department	
	p3 = 0.167	No interaction of cultural biases with sources of communication	

Table 8 (Continued….)

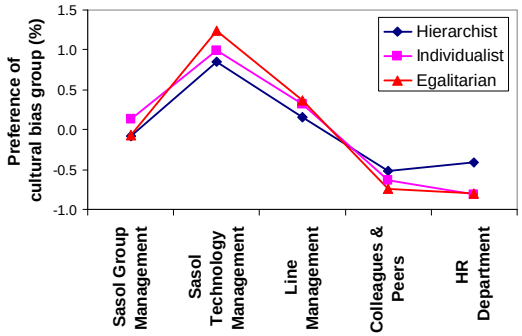
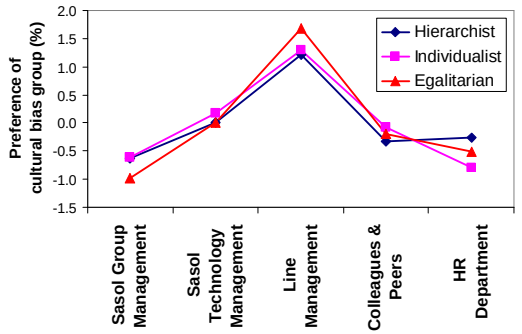
Question number	p-values	Comment	Graphs of communication preferences
3.5.3. Sasol Technology's vision and mission	p1 = 1.000	No significant difference for cultural biases	 **Figure 13: Preferences for communication source pertaining to Sasol Technology's vision and mission**
	p2 = 0.000	Significant differences for source preferences. 1st preference: Sasol Technology Management 2nd preference: Line Management Lowest preference: HR Department, Colleagues & Peers	
	p3 = 0.358	No interaction of cultural biases with sources of communication	
3.5.4. My work responsibilities	p1 = 1.000	No significant difference for cultural biases	 **Figure 14: Preferences for communication source pertaining to work responsibilities**
	p2 = 0.000	Significant differences for source preferences. 1st preference: Line Management 2nd preference: Sasol Technology Management Lowest preference: Sasol Group Management & HR Department	
	p3 = 0.009	Significant interaction of cultural biases with sources of communication. Line Management pref in order E, I, H HR Dept preferences in order H, E, I Lowest preference is E for Sasol Group Management	

Table 8 (Continued….)

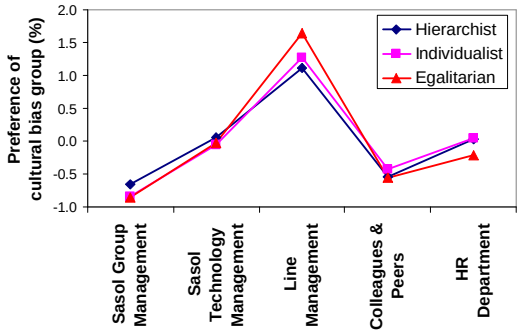
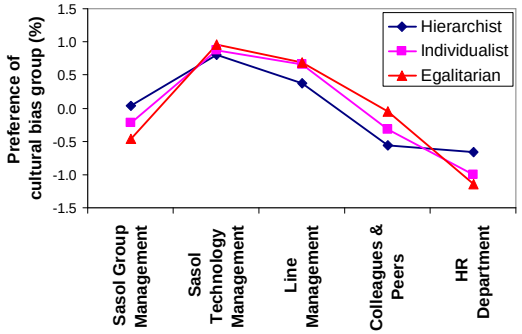
Question number	p-values	Comment	Graphs of communication preferences
3.5.5. How my own performance will be measured	p1 = 1.000	No significant difference for cultural biases	
	p2 = 0.000	Significant differences for source preferences. 1st preference: Line Management 2nd preference: Sasol Technology Management Lowest preference: Sasol Group Management, Colleagues & Peers	
	p3 = 0.415	No interaction of cultural biases with sources of communication	**Figure 15: Preferences for communication source pertaining to how personal performance will be measured**
3.5.6. What Sasol Technology's clients expect of R&D	p1 = 1.000	No significant difference for cultural biases	
	p2 = 0.000	Significant differences for source preferences. 1st preference: Sasol Technology Management 2nd preference: Line Management Lowest preference: HR Department	
	p3 = 0.119	No interaction of cultural biases with sources of communication	**Figure 16: Preferences for communication source pertaining to what Sasol's clients expect of R&D**

Table 8 (Continued….)

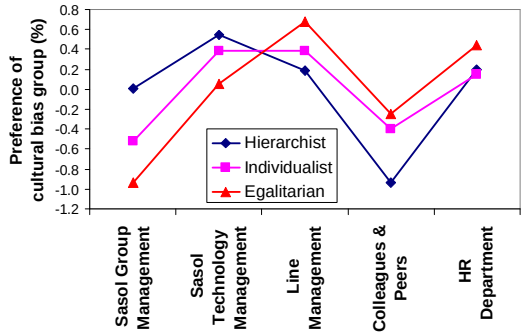
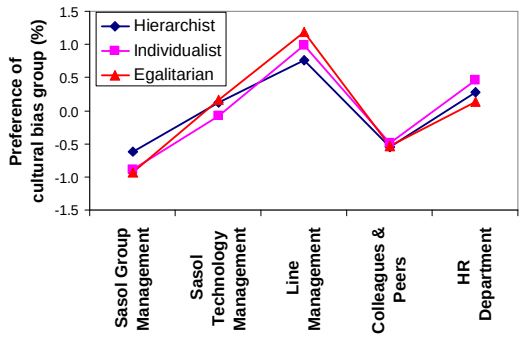
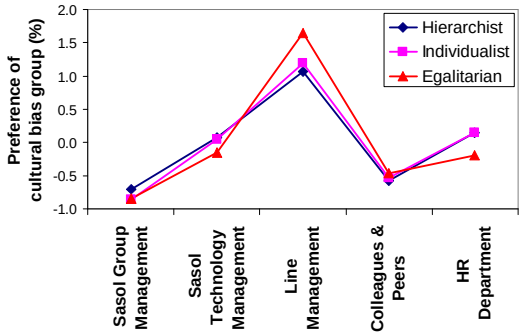
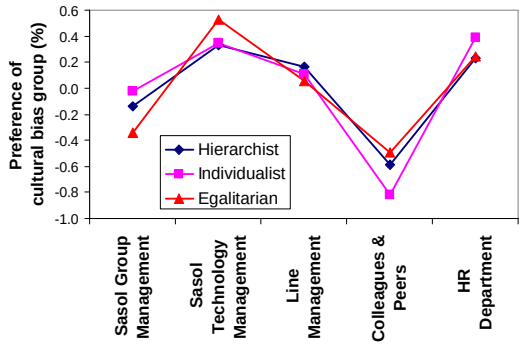
Question number	p-values	Comment	Graphs of communication preferences
3.5.7. Policies, procedures and best practices	p1 = 1.000	No significant difference for cultural biases	
	p2 = 0.000	Significant differences for source preferences. Highest preferences: Sasol Tech Mngt, Line Mngt, HR Dept Lowest preference: Sasol Group Management, Colleagues & Peers	
	p3 = 0.015	Significant interaction of cultural biases with sources of communication. Sasol Technology Mngt & Sasol Group Mngt , pref in order H, I, E Line Mngt, Colleagues & Peers, HR Dept, preferences in order E, I, H	**Figure 17: Preferences for communication source pertaining to policies, procedures and best practices**
3.5.8. Personal development and career paths in Sasol	p1 = 1.000	No significant difference for cultural biases	
	p2 = 0.000	Significant differences for source preferences. 1st preference: Line Management 2nd preference: HR Dept, Sasol Technology Management Lowest preference: Sasol Group Management	
	p3 = 0.351	No interaction of cultural biases with sources of communication	**Figure 18: Preferences for communication source pertaining to personal development and career paths in Sasol**

Table 8 (Continued….)

Question number	p-values	Comment	Graphs of communication preferences
3.5.9. What I have to do to be promoted	p1 = 1.000	No significant difference for cultural biases	 **Figure 19: Preferences for communication source pertaining to requirements for promotion**
	p2 = 0.000	Significant differences for source preferences. Refer to Figure 13. 1st preference: Line Management 2nd preference: HR Dept, Sasol Technology Management Lowest preference: Sasol Group Mngt	
	p3 = 0.222	No interaction of cultural biases with sources of communication	
3.5.10. Company initiatives to create a happier and healthier workforce	p1 = 1.000	No significant difference for cultural biases	 **Figure 20: Preferences for communication source pertaining to company initiatives to create a happier and healthier workforce**
	p2 = 0.000	Significant differences for source preferences. Refer to Figure 14. 1st preference: Sasol Technology Mngt, HR Department 2nd preference: Line Management Lowest preference: Colleagues & Peers	
	p3 = 0.781	No interaction of cultural biases with sources of communication	

4.6.3 Tests for evaluating the relationship between cultural biases and preferences for communication channel

As discussed in Section 3.6, a series of 2-way ANOVA tests (1 per question) were used to evaluate the relationship between the cultural biases of respondents and their preferences for communication channel (or channel). The statistical results are presented in Table 9 below. From the p2-values in Table 9 it can be seen that the differences in preferences for communication channels (for all cultural biases combined) are statistically significant for all 10 communication topics that were evaluated. The p3-values indicate that interactions exist between cultural biases and the preference for communication channels for only one of the communication topics, namely that pertaining to company initiatives to create a happier and healthier workforce (Question 3.6.10). Figures 21 to 30 show how preferences for channel vary for the different cultural bias groups.

Table 9: Results of 2-way ANOVA tests for evaluating the relationship between cultural biases and preferences for communication channel

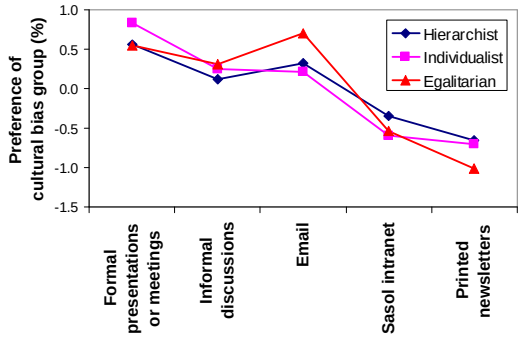
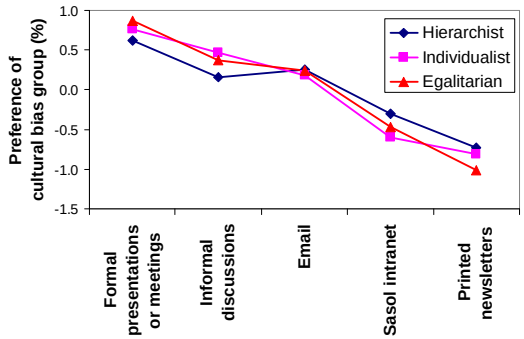
Question number	p-values	Comment	Graphs of communication preferences
3.6.1. How key critical challenges impact my work environment	p1 = 1.000	No significant difference for cultural biases	
	p2 = 0.000	Significant differences for channel preferences. 1st preference: Formal presentations or meetings 2nd preference: E-mail Lowest preference: Printed newsletters, Intranet	
	p3 = 0.247	No interaction of cultural biases with channels of communication	**Figure 21: Preferences for communication channel pertaining to key critical challenges impacting the work environment**
3.6.2. How my work environment fits into the broader Sasol Group strategy	p1 = 1.000	No significant difference for cultural biases	
	p2 = 0.000	Significant differences for channel preferences. 1st preference: Formal presentations or meetings 2nd preference: Informal discussions Lowest preference: Printed newsletters, Intranet	
	p3 = 0.651	No interaction of cultural biases with channels of communication	**Figure 22: Preferences for communication channel pertaining to how work environment fits into the broader Sasol Group Strategy**

Table 9 (Continued….)

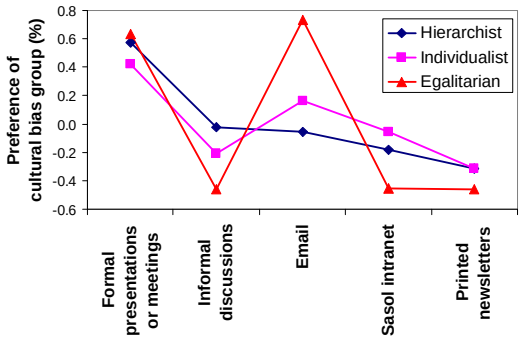
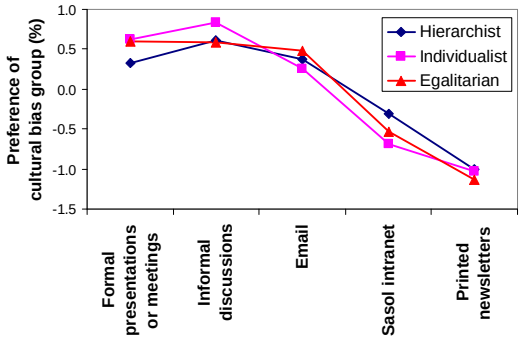
Question number	p-values	Comment	Graphs of communication preferences
3.6.3. Sasol Technology's vision and mission	p1 = 1.000	No significant difference for cultural biases	 **Figure 23: Preferences for communication channel pertaining to Sasol Technology's vision and mission**
	p2 = 0.000	Significant differences for channel preferences. 1st preference: Formal presentations or meetings 2nd preference: E-mail Lowest preference: Printed newsletters, Intranet	
	p3 = 0.246	No interaction of cultural biases with channels of communication	
3.6.4. My work responsibilities	p1 = 1.000	No significant difference for cultural biases	 **Figure 24: Preferences for communication channel pertaining to work responsibilities**
	p2 = 0.000	Significant differences for channel preferences. 1st preference: Informal discussions 2nd preference: Formal presentations or meetings Lowest preference: Printed newsletters, Intranet	
	p3 = 0.260	No interaction of cultural biases with channels of communication	

Table 9 (Continued….)

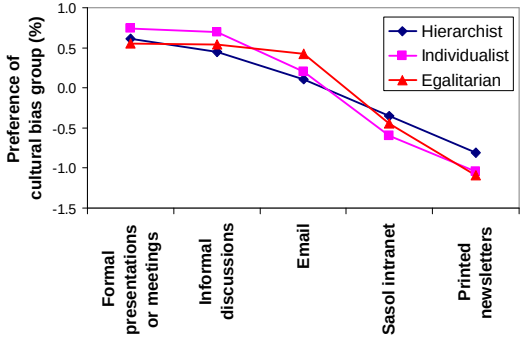
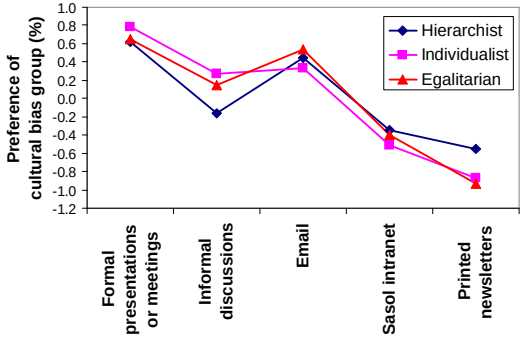
Question number	p-values	Comment	Graphs of communication preferences
3.6.5. How my own performance will be measured	p1 = 1.000	No significant difference for cultural biases	
	p2 = 0.000	Significant differences for channel preferences. 1st preference: Formal presentations or meetings 2nd preference: Informal discussions Lowest preference: Printed newsletters, Intranet	
	p3 = 0.499	No interaction of cultural biases with channels of communication	**Figure 25: Preferences for communication channel pertaining to how personal performance will be measured**
3.6.6. What Sasol Technology's clients expect of R&D	p1 = 1.000	No significant difference for cultural biases	
	p2 = 0.000	Significant differences for channel preferences. 1st preference: Formal presentations or meetings 2nd preference: E-mail Lowest preference: Printed newsletters, Intranet	
	p3 = 0.427	No interaction of cultural biases with channels of communication	**Figure 26: Preferences for communication channel pertaining to what Sasol's clients expect of R&D**

Table 9 (Continued….)

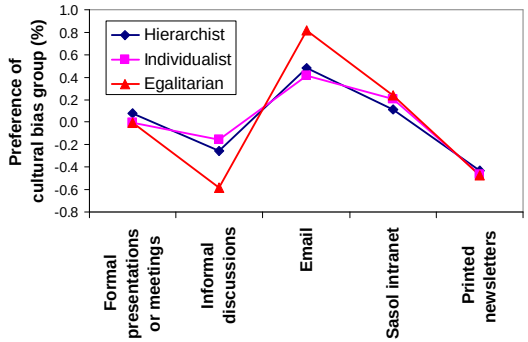
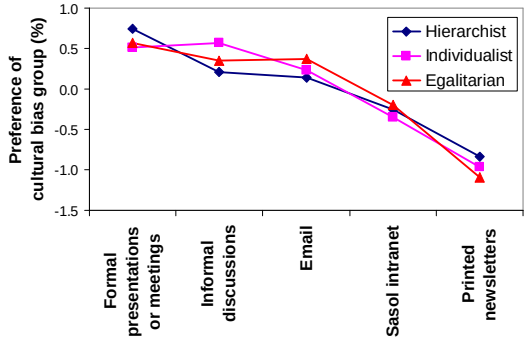
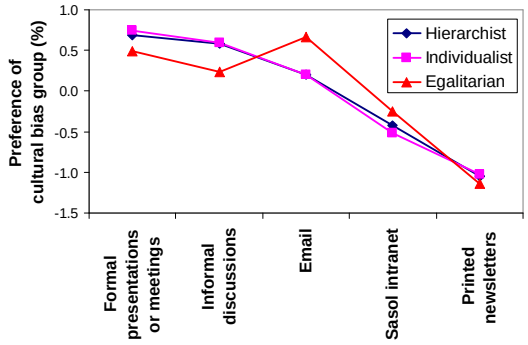
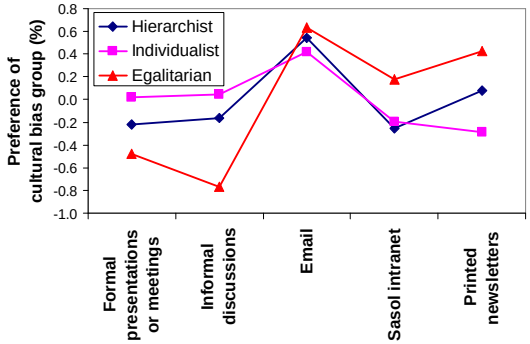
Question number	p-values	Comment	Graphs of communication preferences
3.6.7. Policies, procedures and best practices	p1 = 1.000	No significant difference for cultural biases	 **Figure 27: Preferences for communication s channel pertaining to policies, procedures and best practices**
	p2 = 0.000	Significant differences for channel preferences. 1st preference: E-mail 2nd preference: Sasol Intranet Lowest preference: Printed newsletters, Informal discussions	
	p3 = 0.775	No interaction of cultural biases with channels of communication	
3.6.8. Personal development and career paths in Sasol	p1 = 1.000	No significant difference for cultural biases	 **Figure 28: Preferences for communication channel pertaining to personal development and career paths in Sasol**
	p2 = 0.000	Significant differences for channel preferences. 1st preference: Formal presentations or meetings 2nd preference: Informal discussions Lowest preference: Printed newsletters, Intranet	
	p3 = 0.648	No interaction of cultural biases with channels of communication	

Table 9 (Continued….)

Question number	p-values	Comment	Graphs of communication preferences
3.6.9. What I have to do to be promoted	p1 = 1.000	No significant difference for cultural biases	 **Figure 29: Preferences for communication channel pertaining to requirements for promotion**
	p2 = 0.000	Significant differences for channel preferences. 1st preference: Formal presentations or meetings 2nd preference: Informal discussions Lowest preference: Printed newsletters, Intranet	
	p3 = 0.218	No interaction of cultural biases with channels of communication	
3.6.10. Company initiatives to create a happier and healthier workforce	p1 = 1.000	No significant difference for cultural biases	 **Figure 30: Preferences for communication channel pertaining to company initiatives to create a happier and healthier workforce**
	p2 = 0.000	Significant differences for channel preferences. 1st preference: Email Lowest preference: All others are similar on average (for all cultural biases combined)	
	p3 = 0.005	Significant interaction of cultural biases with channels of communication. E-mail: Highest preference, but similar for H, I & E Formal presentations and meetings: Order of preference is I, H, E Informal discussions: Order of preference is I, H,E Printed newsletters: Order of preference is E, H, I Sasol intranet: Order of preference is E, I, H	

4.6.4 Internal reliability of the questionnaire for preferences of communication

The internal reliability of the questionnaire with regards to the questions on communication preferences were verified by calculating the Cronbach alpha coefficients (Cronbach, 1951) for each of the groups of questions for communication preferences. The Cronbach alpha coefficients for each of the groups of questions are shown in Table 10 below. It can be seen that the Cronbach alpha coefficients for sources and channel of communication are below the acceptable value of 0.6, and subsequently two more reliability tests were performed, namely the split-half test and the Spearman-Brown test (De Wet et al, 1981). Since both of these additional tests gave acceptable values for internal reliability, it is concluded that all three groups of questions on communication preferences are internally consistent and reliable.

Table 10: Cronbach alpha coefficients – Test for internal reliability of questions on communication preferences

Groups of questions	Cronbach alpha coefficient	Split-half coefficient	Spearman-Brown coefficient
Frequency of communication	0.901	0.853	0.921
Sources of communication	0.206	0.695	0.820
Channels of communication	0.381	0.803	0.891

4.6.5 Conclusion pertaining to the relationship between cultural biases and communication preferences

From statistical results presented in Tables 7, 8 and 9 it is concluded that the cultural characteristics of individuals that were sampled are not independent of their preferences of communication frequency, source and channel. Relationships were found for a limited number of the communication topics that were investigated, but they are nevertheless statistically significant at the 5% significance level.

4.7 Summary of the results

The results obtained from the statistical evaluation can be summarised as follows:

- A response rate of 22.3% was obtained.
- All sections in the questionnaire that was used to obtain the data for this study comply with the requirement of internal consistency reliability.
- Using the grid-group culture typology instrument, it was found that 59% of respondents can be typed as individualists, 11.9% as hierarchists, 10.4% as egalitarians, and only 3.0% as fatalists.
- The 1-way ANOVA tests for evaluating the relationship between cultural biases and the perceptions of communication frequency indicate independency for all 10 of the communication topics that were evaluated.
- The χ^2 tests for independence that were used to evaluate the relationship between cultural biases and perceptions of communication source indicate independency for 9 of the 10 communication topics that were evaluated (i.e. no relationship). A relationship was identified between the

cultural biases and the perception of the sources for communication on the topic of promotion requirements.

- The χ^2 tests for independence that were used to evaluate the relationship between cultural biases and perceptions of communication channel indicate independency for all 10 communication topics that were evaluated (i.e. no relationship).

- The 1-way ANOVA tests for evaluating the relationship between cultural biases and preferences for communication frequency indicate independency for 9 of the 10 the communication topics that were evaluated (i.e. no relationship). A relationship was identified between cultural biases and preferences for the frequency of communication on the topic of policies, procedures and best practices.

- The 2-way ANOVA tests for evaluating the relationship between cultural biases and preferences for communication source indicate independency for 8 of the 10 the communication topics that were evaluated (i.e. no relationship). Relationships between the cultural biases and the preferences for communication source were identified on the topics of (a) work responsibilities, and (b) policies, procedures and best practices. The preferences for source of communication are statistically significant for all 10 of the communication topics if the effect of cultural bias is ignored (i.e. in the absence of interaction).

- The 2-way ANOVA tests for evaluating the relationship between cultural biases and preferences for communication channel indicate independency for 9 of the 10 the communication topics that were evaluated (i.e. no relationship). A relationship was identified between the cultural biases and preferences for communication channel on the topic of company initiatives to create a happier and healthier workforce. The preferences for channel of communication are statistically significant for all 10 of the communication topics if the effect of cultural bias is ignored (i.e. in the absence of interaction).

5 DISCUSSION OF THE RESULTS

5.1 Introduction

In this chapter the results from this study is discussed, with emphasis on how the results relate to the literature on grid-group culture typology, communication behaviour.

5.2 Demographic profile of respondents

Although the possible interaction of demographic variables with the cultural biases and communication behaviour of respondents are not within the scope of the current study, the demographic profile of respondents provides insight into the characteristics of the sample. The following observations are made:

- It was found that the response rates according to gender are in excellent agreement with the data reported by Zander (2004), who also conducted a survey in the corporate South African environment. It is thus concluded that there is no sample bias towards males or females.

- The response rates according to employment level indicate an unrealistically low response by employees on the lowest level of the organisation (i.e. Level 7). The response rates according to employment level indicate a response rate of 89.6% for tertiary qualified respondents. Since most of the employees with tertiary educational qualifications are expected to be on Levels 6 to Level 2, it is concluded that less qualified employees were more reluctant to respond to the survey. It is not known how this sampling bias affects the results and conclusions from this study.

- From the response rates according to years of service, it was found that two thirds of all the employees are in the service of the organisation for 10 years or less. This result is indicative of a fairly high turn-over of

employees. In a knowledge intensive environment like a R&D organisation, high turn-over of employees poses significant challenges for knowledge retention and knowledge management, but this topic falls outside the scope of the current study.

- The response rates according to language indicate reluctance among black African employees to partake in the communication survey. It is not known to what extent this result can influence the conclusions drawn from this study, since the effect of demographic variables on communication behaviour falls outside the scope of this study.

5.3 Discussion pertaining to the predominant cultural bias

The results from the survey with regards to grid-group culture typology indicate that 59.5% of the respondents have an individualistic cultural bias, 11.9% have a hierarchical cultural bias, 10.4% are egalitarians, 3.0% are fatalists, and 15.7% have more than one cultural bias preference. These numbers do not suggest any sample bias towards egalitarians, which is regarded as one of the shortcomings of the original grid-group culture typology instrument proposed by Dake (1991) (Marris et al, 1998). It appears that the improved grid-group culture typology instrument of Rippl (2002) which was used in this study is not prone to the egalitarian sample bias problem.

The cultural bias distribution further indicates that very few respondents have a fatalistic cultural bias, which is agreement with the findings of Marris et al (1998), albeit that Marris et al (1998) did not survey an organisational R&D environment. Fatalists, according to grid-group culture typology, are typically controlled by external factors, they have little individual autonomy, and have little choice about whom they associate with (Thompson et al, 1990). The high education level found in the R&D environment indicate that employees in this environment take charge of their own destiny, and it can therefore be expected to find very few

fatalists in this environment. The work of Bendixen (2003) and Steeneveldt (2005) suggest the triggering of a cultural bias change towards fatalism by bureaucratisation. Therefore the low incidence of fatalism could be interpreted as being indicative of the fact that the R&D organisation that was sampled is not overly bureaucratic.

The cultural bias measurement indicates that 15.7% of the respondents could not be assigned to one unique cultural bias group, but have high scores in more that one culture group. This result is consistent with the literature (see Marris et al, 1998; Palmer, 1996; Oltendal et al, 2004), yet the percentage of respondents belonging to more than one cultural bias is significantly lower than what was observed in the studies of Marris et al (1998) and Palmer (1996). The advantage of this result is that the majority of the data could be used in subsequent statistical analyses (only 15.7% of the data could not be used due to multiple cultural biases).

The most significant finding from the grid-group culture measurement is the fact that 59% of the respondents adhere to the individualistic cultural bias. This finding gives overwhelming support to Proposition 1, which proposed that the cultural biases (or ways of life) of employees in a high-tech R&D environment are predominantly individualistic. The characteristics of individualists pose a challenge to those who have to manage them, since individualists are not bound by prescribed rolls, boundaries are provisional and negotiable, they prefer to be free from control by others, and prefer to be in a control position (Thompson et al, 1990).

5.4 Discussion pertaining to the relationship between cultural biases and communication perceptions

The 2nd proposition for this study proposes that a relationship exists between the cultural characteristics of individuals working in a high-tech R&D organisation and their perceptions of communication. The three dimensions of communication that were evaluated are those of frequency, source and channel. From the statistical analysis that was conducted, which includes 1-way ANOVA tests and χ^2 tests for independence, only a very limited number of statistically significant relationships could be found between cultural biases and the perception of communication (in fact only one out of 30). Considering the fact that cultural biases are said to be influenced by perceptions about life (Thompson et al, 1990), and considering the literature suggesting that communication behaviour is strongly influenced by perceptions (Ricks & Gow, 1987; Reitz, 1977; Sigband & Bell, 1989; Smallman & Weir, 1999), very little quantitative evidence was found in this study to support any relationship between cultural biases and communication perceptions. Although a fair amount of criticism against grid-group culture theory exists in the open literature (Marris et al, 1998), it is not clear whether the absence of stronger relationships between cultural biases and communication perceptions are related to an inherent shortcoming of culture theory, or the fact that perception (and specifically communication perception) is too subjective to allow a quantitative evaluation, or simply because the relationships just do not exist at all. The evidence at hand suggests the latter, particularly since the cultural typology instrument and the survey questions for communication preferences fully comply with the criteria for internal validity. The independency of cultural biases on communication preferences in the current study is supported by Tagiuri (Tagiuri, 1969, as quoted by Reitz, 1977), who stated that no consistent relationships exist between personality variables and perceptual process.

The only relationship between cultural biases and communication perceptions is on the topic of promotion requirements. All three cultural biases that were

evaluated have a perception that they get communication about promotion requirements primarily from Line Management (see Figure 3). Although the proportions of the cultural groups which get their information from Line Management are statistically significant (i.e. 70% for egalitarians, 56% for individualists, and 44% for hierarchists), this finding has little practical value since all cultural biases scored high on the same communication source (i.e. Line Management), with lower scores for the other sources.

Based on the results of the statistical evaluation, and the discussion above, not enough evidence was found to support Proposition 2, which proposed that there is a relationship between the cultural characteristics of individuals working in a high-tech R&D organisation and their perceptions of communication.

5.5 Discussion pertaining to the relationship between cultural biases and communication preferences

The 3rd proposition for this study proposes that there is a relationship between the cultural characteristics of individuals working in a high-tech R&D organisation and their preferences for communication frequency, source and channel. From the statistical analyses that were conducted, using 1-way and 2-way ANOVA tests, only 4 out of 30 relationships that were tested for were found to be statistically significant. Therefore the preferences of hierarchists, individualists and egalitarians are similar for 26 of the 30 relationships that were checked, suggesting that communication preference differences between the different cultural biases are present, but limited. The 4 statistically significant relationships between cultural biases and communication preferences indicate the following:

- Hierarchists, individualists and egalitarians prefer different frequencies of communication relating to policies, procedures and best practices. Hierarchists prefer very frequent communication (9.7 times per year), and

individualists have the lowest frequency preference (3.5 times per year). This finding suggests consistency with grid-group culture theory, in the sense that individualists, who see boundaries (in this case policies, procedures and best practices) as provisional and subject to negotiation (Thompson et al, 1990), prefer a lower frequency of communication (i.e. they require less frequent updates of the effect of control boundaries on them) to that of hierarchists and egalitarians, who have strong group boundaries.

- The overall preference for information about work responsibility is to get it from Line Management, and all three cultural biases have consistent highest scores for this preference. The statistical significance of the cultural bias interaction on the preferences for communication source pertaining to work responsibilities can be seen in Figure 8. Egalitarians, if compared to individualists and hierarchists, have a higher preference for obtaining information about work responsibilities from sources closer to them in the organisational hierarchy (i.e. Line management, Colleagues and Peers), whereas hierarchists and individualists (if compared to egalitarians) prefer to get information on work responsibilities from sources higher up in the organisational hierarchy (Sasol Group Management and Sasol Technology Management). This observation is consistent with grid-group culture theory in the sense that egalitarians do not grant other individuals the authority to exercise control over them by virtue of their position (Thomas et al, 1990).

- The HR Department, which represents a significant control boundary within the organisation, is least preferred by individualists as a source of information for work responsibilities, with hierarchists having higher preference ratings than individualists and egalitarians (Figure 8). This result is again consistent with grid-group culture theory with regards to the adherence and/or avoidance of cultural biases to boundaries (Thompson et al, 1990).

- The preferences of the different cultural biases for the source of information pertaining to policies, procedures and best practices are shown in Figure 11. These preferences are consistent with the preferences relating to work responsibilities (discussed above) in the sense that egalitarians prefer to get information from sources closer to them in the organisational hierarchy (i.e. Line Management, Colleagues and Peers), whereas hierarchists and individualists (if compared to egalitarians) prefer to get information on policies, procedures and best practices from sources higher up in the organisational hierarchy (Sasol Group Management and Sasol Technology Management). This observation is again consistent with grid-group culture theory in the sense that egalitarians do not grant other individuals the authority to exercise control over them by virtue of their position (Thomas et al, 1990).

- The preferences of the different cultural biases for the channel of communication pertaining to company initiatives to create a happier and healthier workforce, are shown in Figure 24. It can be seen that email is the channel of communication which is most preferred by all three cultural bias groups. Figure 24 also shows that egalitarians have higher preferences than hierarchists and individualists for communication via email, the intranet and printed newsletters, whereas egalitarians have lower preferences than hierarchists and individualists for communication via personal interaction (formal presentations, meetings and informal discussions). These preferences differences between cultural bias groups are consistent with grid-group culture theory in the sense that egalitarians (who lack internal role definition according to Thompson et al (1990)) prefer to get information via impersonal channels like email, the intranet and printed newsletters. Contrary to this, individualists and hierarchists, who do not suffer from a lack of role definition, have higher preferences than egalitarians for formal presentations, meetings and informal discussions, where there is no uncertainty about who the role players (i.e. communicators) are.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

In this chapter conclusions are drawn from the results obtained in this study, with emphasis on (a) the validity of the study, (b) the results from the grid-group culture typology measurement, (c) the relationship between cultural biases and the perceptions of communication in the R&D environment, and (d) the relationship between cultural biases and the preferences for communication in the R&D environment. From these conclusions will flow recommendations and suggestions for further research.

6.2 Summary of conclusions of the study

The purpose of this study is to determine if grid-group culture theory can be used as a framework for better understanding the interaction between organisational culture and the perceptions of and preferences for communication in the corporate R&D environment in South Africa.

In applying the grid-group culture typology measuring instrument, the South African R&D organisational culture was characterised by the individual cultural bias profile of individuals employed by one of the largest R&D organisations in South Africa, having more than 600 employees. It is concluded that employees in this environment are highly qualified, and their predominant cultural bias is that of individualism. It is concluded that fatalism is not a significant cultural bias preference in South African R&D organisations, and that this finding is consistent with the fact that employees in R&D organisations take charge of their own destiny, since they have high education levels. It is also concluded from the low incidence of fatalism that was observed, that South African R&D organisations are not overly bureaucratic. It is further concluded that the

improved cultural bias typology measuring instrument of Rippl (2002) does not have sample towards egalitarianism, and satisfies the requirements for internal validity.

From the limited number of statistically significant relationships between cultural biases of employees in the R&D organisation and their communication perceptions and preferences, it is concluded that the “qualitative” literature which acknowledges the role of cultural differences (also referred to as worldviews or ways of life) in communication behaviour, is only supported to a very limited extent by results from this quantitative study, which relied on grid-group culture theory as a quantitative indication of cultural bias preferences. Although grid-group culture theory has found widespread application in the field of risk perception, the results from the current study suggest that grid-group culture theory is not the most appropriate framework for understanding the complexities of communication behaviour. Despite this, the few statistically significant relationships that could be identified indicate that communication preferences of the different cultural bias groups are consistent with the characteristics of the individual cultural biases according to grid-group culture theory. Significant differences in the preferences of the three cultural bias groups (i.e. hierarchism, individualism and egalitarianism) were identified for (a) communication frequency pertaining to policies, procedures and best practices, (b) communication source pertaining to work responsibilities, (c) communication source pertaining to policies, procedures and best practices, and (d) communication channel pertaining to company initiatives to create a happier and healthier workforce.

6.3 Recommendations

The findings of this study provide guidance to managers and human resource specialists for the achievement more effective communication within high-tech R&D organisations, which are dependent upon the technical skills of engineers

and scientists for maintaining and sustaining the organisation's competitive advantage. It is recommended that managers, human resource specialists and communication specialists take cognisance of the unique individual characteristics of employees found in the R&D environment, where the majority of employees have an individualistic world view (or way of life). Individualists generally regard boundaries as provisional and subject to negotiation, they prefer to be free of control by others, and like to be in controlling positions. This poses a unique challenge to managers and communication specialists in the high-tech R&D environment, particularly so because of the role these employees play in sustaining the organisation's competitive advantage.

This study aimed to fill the gap that exists in literature regarding the difference between the perception of and the preference for particular communication dimensions, since no clear distinction is made between the concepts of perception and preference in the literature on organisational communication. Based on the findings of this study, as well as the fact that preferences of employees are something tangible which can be acted upon by management (as opposed to perceptions which are largely uncontrollable), it is recommended that organisations focus their efforts to improve business communication on the preferences of employees, rather on how effective communication is perceived to be. It is recommended to design questionnaires for communication surveys in a way that preferences are measured very explicitly, and not to leave open possibilities where perception differences could cloud the outcome and results of such surveys. By avoiding the influence of individual perceptions on the evaluation of communication behaviour, the chances of finding meaningful results from communication surveys will be increased substantially.

6.4 Suggestions for further research

Based on the findings from this study, the following suggestions for further research are made:

- This study was limited to sampling in one R&D organisation in South Africa. It is suggested to expand this study to other South African R&D organisations, and possibly even to international organisations. By doing so, the external validity of findings from this study can be improved. The research problem for such a study would be (a) to determine if the independency between cultural biases and communication perceptions are valid for other South African R&D organisations, and (b) to determine if the relationship between cultural biases and communication preferences are valid for other South African R&D organisations.

- In repeating this study in other R&D organisations, it is suggested to improve the sampling procedure to ensure an adequate representation in the sample of all ethnic groups and all qualification levels within the larger population.

- Since the grid-group culture typology instrument for measuring cultural bias preferences showed to have limited success in describing communication behaviour, it is suggested to use alternative instruments to describe the personal characteristics of individuals. Such a study will indicate if the limited number of relationships between individual characteristics and communication behaviour are related to shortcomings of grid-group culture theory if applied in the communication environment. The research problem for such a study would be to identify a behavioural measuring instrument for which the individual characteristics of employees in R&D organisations are more closely related with their communication perceptions and preferences than what is found when using grid-group culture typology.

- This study did not aim to explain the reasons for possible differences between communication perceptions and preferences. However, managers, human resource specialists and communication specialists can gain insight into the shortcomings of their communication strategy by making a detailed study of these differences. An obvious example is the fact that results from this study indicate that employees perceive to get information about promotion requirements only once per year (most likely at the merit discussion), whereas they prefer to have such information at 3-monthly intervals. It is therefore recommended to conduct a thorough statistical analysis of the data from this study to identify discrepancies between communication perceptions and preferences.

- This study did not attempt to explore relationships between demographic variables and cultural biases, nor the existence of relationships between demographic variables and the perceptions of and preferences for communication frequency, source or channel. Such a study is recommended since it could potentially make a significant contribution to the findings of the current study. The research problem for such a study would be (a) to identify the relationship between demographic variables of individuals in a R&D organisation and their cultural biases according to grid-group culture theory, and (b) to identify the relationship between the demographic variables of individuals in a R&D organisation and their perceptions and preferences of communication.

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APPENDIX A: Questionnaire

Cover letter:

Dear R&D staff member

Please take part in this questionnaire.

The purpose of this questionnaire is to determine if your personal perceptions and preferences have an effect on how you experience communication in the R&D environment. Results of this survey will be used for purposes of MBA research at the University of the Witwatersrand. It is believed that the results from this study will enable a better understanding of the communication barriers and challenges which face the rather unique and diverse culture within the R&D environment.

Your responses will be treated as confidential, and your response will never be linked to you.

This survey can be completed in paper or electronic format. Anonymous paper copies can be sent via internal mail to Cecilia de Bruin or to Martin Keyser, Sasol Technology R&D Division, Sasolburg. Electronic copies may be sent to cecilia.debruin@sasol.com or to martin.keyser@sasol.com.

I will appreciate if I could have your responses by **Friday 19 September 2008.**

If you encounter any systems problems or have any concerns relating to the submission of your survey results, you may contact Cecilia de Bruin (x60-6001 or email at cecilia.debruin@sasol.com), or you may contact me directly (x60-3551 or email at martin.keyser@sasol.com).

Thank you for your time and willingness to complete this questionnaire.

Martin Keyser

General information and instructions for completing this questionnaire:

- It will take approximately 15 minutes of your time to complete the questionnaire.
- The questionnaire consists of the following 3 parts:
  - Part 1: General information about the respondent.
  - Part 2: An evaluation instrument from the open literature which is used to assess the respondent's view of the world.
  - Part 3: Ten questions about communication in the R&D environment.

Please read every question carefully before you answer it.

QUESTIONNAIRE

Part 1:

Please provide your personal details by ticking **(✓)** or crossing **(x)** the appropriate boxes in Questions 1.1 to 1.3, and filling out the boxes in Questions 1.4 to 1.6.

Questions (Part 1)												
1.1	Are you male or female?	Male		Female								
1.2	What is your post level in the company?	7 and below		6		5		4		3 and above		
1.3	What is your highest qualification?	Matric or other school grade		Diploma or Bachelors degree		Masters degree or Masters diploma		PhD or equivalent		Other (please specify)		
1.4	What is your age in years?											
1.5	How many years have you been employed by R&D?											
1.6	What is you home language?											

Part 2:

Please think of an ideal job and social environment (disregarding your present job). Please rate the following statements by ticking **(✓)** or crossing **(x)** the column which you personally think is most appropriate.

	Statements (Part 2)	Strongly disagree	Disagree	Don't agree or disagree	Agree	Strongly agree
2.1.1	I think there should be more discipline in the youth of today.					
2.1.2	I would support the introduction of compulsory National Service.					
2.1.3	I am more strict than most people about what is right and wrong.					
2.1.4	We should have stronger armed forces than we do now					
2.1.5	The police should have the right to listen to private phone calls when investigating crime.					
2.1.6	Those in power often withhold information about things which are harmful to us					
2.1.7	One of the problems with people is that they challenge authority too often.					
2.1.8	It is important to preserve our customs and heritage.					
2.1.9	I think it is important to carry on family traditions.					
2.1.10	In my household, family members have their own places at the dinner table.					
2.1.11	I always sort out clothes into separate categories before washing.					
2.1.12	I value regular routines highly.					
2.1.13	I think being on time is important.					
2.1.14	My time-tabling of meals is haphazard.					
2.1.15	I like to plan carefully so that financial risks are not taken					

	Statements (Part 2)	Strongly disagree	Disagree	Don't agree or disagree	Agree	Strongly agree
2.2.1	In a fair system people with more ability should earn more					
2.2.2	A free society can only exist by giving companies the opportunity to prosper.					
2.2.3	If a person has the get-up-and-go to acquire wealth, that person should have the right to enjoy it.					
2.2.4	It is just as well that life tends to sort out those who try harder from those who don't.					
2.2.5	Continued economic growth is the answer to improved quality of life.					
2.2.6	This country would be better off if we didn't worry so much about how equal people are.					
2.2.7	Making money is the main reason for hard work.					
2.2.8	I don't join clubs of any kind.					
2.2.9	I tend to be sceptical of health food fads.					
2.3.1	If people in this country were treated more equally we would have fewer problems.					
2.3.2	The government should make sure everyone has a good standard of living.					
2.3.3	Those who get ahead should be taxed more to support the less fortunate.					
2.3.4	I would support a tax change that made people with large incomes pay more.					
2.3.5	The world could be a more peaceful place if its wealth were divided more equally among nations.					
2.3.6	A national pension fund tends to stop people from trying harder to get on.					
2.3.7	Racial discrimination is a very serious problem in our society.					
2.3.8	What this country needs is a 'fairness revolution' to make the distribution of goods more equal.					
2.3.9	Most of the meals I eat are vegetarian.					
2.3.10	Health requirements are very important in my choice of foods.					
2.3.11	I prefer simple and unprocessed foods.					

	Statements (Part 2)	Strongly disagree	Disagree	Don't agree or disagree	Agree	Strongly agree
2.4.1	There is no use in doing things for other people – you only get it in the neck in the long run.					
2.4.2	Cooperating with others rarely works.					
2.4.3	The future is too uncertain for a person to make serious plans.					
2.4.4	I have often been treated unfairly.					
2.4.5	A person is better off if he or she doesn't trust anyone.					
2.4.6	I don't worry about politics because I can't influence things very much.					
2.4.7	Most people make friends only because friends are useful to them.					
2.4.8	I feel that life is like a lottery.					
2.4.9	Even if you work hard you never know if that will help you do better.					
2.4.10	It seems to me that, whoever you vote for, things go on pretty much the same.					
2.4.11	I have few financial investments.					

Part 3:
Please think of communication in your current environment and present job.

Please note than some boxes allow only one selection per item, while other boxes allow multiple selections.

3.1 Please indicate ***how often*** you receive information on each of the following topics or issues – please tick **(✓)** or cross **(x) only one** box per item.

	Once or more per week	Less than once per week but **at least once per month**	Less than once per month but **at least once per 3 months**	Less than once per 3 months but **at least once per 6 months**	Less than once per 6 months but **at least once per year**	**Less than once per year**
3.1.1. How key critical challenges impact my work environment						
3.1.2. How my work environment fits into the broader Sasol Group strategy						
3.1.3. Sasol Technology's vision and mission						
3.1.4. My work responsibilities.						
3.1.5. How my own performance will be measured						
3.1.6. What Sasol Technology's clients expect of R&D						
3.1.7. Policies, procedures and best practices						
3.1.8. Personal development and career paths in Sasol						
3.1.9. What I have to do to be promoted						
3.1.10. Company initiatives to create a happier and healthier workforce						

3.2 Please indicate ***from whom*** you receive information on each of the following topics or issues – you may tick **(✓)** or cross **(x) more than one** box per item

	Sasol Group Management	Sasol Technology Management	Line Management	Colleagues & peers	HR department	Other (please specify)
3.2.1. How key critical challenges impact my work environment						
3.2.2. How my work environment fits into the broader Sasol Group strategy						
3.2.3. Sasol Technology's vision and mission						
3.2.4. My work responsibilities.						
3.2.5. How my own performance will be measured						
3.2.6. What Sasol Technology's clients expect of R&D						
3.2.7. Policies, procedures and best practices						
3.2.8. Personal development and career paths in Sasol						
3.2.9. What I have to do to be promoted						
3.2.10. Company initiatives to create a happier and healthier workforce						

3.3 Please indicate ***how*** you receive information on the following topics or issues –you may tick **(✓)** or cross **(x) more than one** box per item

	Formal presentations or meetings	Informal discussions	Email	Sasol intranet	Printed newsletters	Other (please specify)
3.3.1. How key critical challenges impact my work environment						
3.3.2. How my work environment fits into the broader Sasol Group strategy						
3.3.3. Sasol Technology's vision and mission						
3.3.4. My work responsibilities.						
3.3.5. How my own performance will be measured						
3.3.6. What Sasol Technology's clients expect of R&D						
3.3.7. Policies, procedures and best practices						
3.3.8. Personal development and career paths in Sasol						
3.3.9. What I have to do to be promoted						
3.3.10. Company initiatives to create a happier and healthier workforce						

3.4 Please indicate ***how often*** you *would like to* receive information on the following topics or issues – please tick **(✓)** or cross **(x) only one** box per item.

	Once or more per week	Less than once per week but **at least once per month**	Less than once per month but **at least once per 3 months**	Less than once per 3 months but **at least once per 6 months**	Less than once per 6 months but **at least once per year**	**Less than once per year**
3.4.1. How key critical challenges impact my work environment						
3.4.2. How my work environment fits into the broader Sasol Group strategy						
3.4.3. Sasol Technology's vision and mission						
3.4.4. My work responsibilities.						
3.4.5. How my own performance will be measured						
3.4.6. What Sasol Technology's clients expect of R&D						
3.4.7. Policies, procedures and best practices						
3.4.8. Personal development and career paths in Sasol						
3.4.9. What I have to do to be promoted						
3.4.10. Company initiatives to create a happier and healthier workforce						

3.5 Please indicate your *preference*s regarding ***who*** communicates information on the following topics or issues. Please use "1" for your most preferred source and "5" for the least preferred source; and please rank all sources for all topics (i.e. there should be a number in each box).

	Sasol Group Management	Sasol Technology Management	Line Management	Colleagues & peers	HR department
Example: Receiving the daily weather forecast	2	5	1	4	3
3.5.1. How key critical challenges impact my work environment					
3.5.2. How my work environment fits into the broader Sasol Group strategy					
3.5.3. Sasol Technology's vision and mission					
3.5.4. My work responsibilities.					
3.5.5. How my own performance will be measured					
3.5.6. What Sasol Technology's clients expect of R&D					
3.5.7. Policies, procedures and best practices					
3.5.8. Personal development and career paths in Sasol					
3.5.9. What I have to do to be promoted					
3.5.10. Company initiatives to create a happier and healthier workforce					

3.6 Please indicate your *preferences* regarding ***how*** information on the following topics or issues is communicated. Please use "1" for your most preferred medium and "5" for the least preferred medium; and please rank all media for all topics (i.e. there should be a number in each box).

	Formal presentations or meetings	Informal discussions	Email	Sasol intranet	Printed newsletters
Example: Receiving the daily weather forecast	1	4	2	5	3
3.6.1. How key critical challenges impact my work environment					
3.6.2. How my work environment fits into the broader Sasol Group strategy					
3.6.3. Sasol Technology's vision and mission					
3.6.4. My work responsibilities.					
3.6.5. How my own performance will be measured					
3.6.6. What Sasol Technology's clients expect of R&D					
3.6.7. Policies, procedures and best practices					
3.6.8. Personal development and career paths in Sasol					
3.6.9. What I have to do to be promoted					
3.6.10. Company initiatives to create a happier and healthier workforce					

APPENDIX B: EXAMPLE OF DISTRIBUTION FITTING FOR COMMUNICATION FREQUENCY DATA

	Rate per year	Log(Rate)	Observed	Expected	χ^2 Contrib	
Once per week	52	1.716003	2	1.4	0.2339	
Once per month	12	1.079181	3	4.0	0.2417	
per 3 mnth	4	0.60206	4	4.0	0.0000	
per 6mth	2	0.30103	3	2.1	0.4396	
once per year	1	0	2	1.4	0.3088	
Less than 1 per yr			0	1.2	1.1837	
TOTAL			14		2.4077	Value to be minimised

Mean	μ	0.891337	(Variable 1 of regression alhorithm)
Std dev	σ	0.648201	(Variable 2 of regression alhorithm)

APPENDIX C: EXAMPLE 1-WAY ANOVA TEST

Summary stats for samples

	Hierarchists	Individualists	Egalitarians
Sample sizes	16	79	14
Sample means	1.002	0.697	0.891
Sample standard deviations	0.656	0.615	0.648
Sample variances	0.430	0.378	0.420
Weights for pooled variance	0.142	0.736	0.123

Number of samples	3
Total sample size	109
Grand mean	0.767
Pooled variance	0.390
Pooled standard deviation	0.625

OneWay ANOVA table

Source	SS	df	MS	F	p-value
Between variation	1.486	2	0.743	1.904	0.1541
Within variation	41.377	106	0.390		
Total variation	42.864	108			

APPENDIX D: EXAMPLE OF THE χ^2 TEST FOR INDEPENDENCE

Observed counts

Hierarchist	Individualist	Egalitarian		
0	1	0		1
3	1	0		4
11	55	14		80
7	15	5		27
4	17	1		22
0	9	0		9
25	98	20	143	143

Expected

Hierarchist	Individualist	Egalitarian		
0.175	0.685	0.140		1
0.699	2.741	0.559		4
13.986	54.825	11.189		80
4.720	18.503	3.776		27
3.846	15.077	3.077		22
1.573	6.168	1.259		9
25	98	20	143	143

χ^2 contributions

Hierarchist	Individualist	Egalitarian
0.1748252	0.14449836	0.1398601
7.5693007	1.10605466	0.5594406
0.637514	0.00055748	0.7063112
1.1010205	0.66336045	0.3965941
0.0061538	0.24529042	1.4019231
1.5734266	1.30048523	1.2587413

Observed percentages column totals

Hierarchist	Individualist	Egalitarian
0.0%	1.0%	0.0%
12.0%	1.0%	0.0%
44.0%	56.1%	70.0%
28.0%	15.3%	25.0%
16.0%	17.3%	5.0%
0.0%	9.2%	0.0%
100%	100%	100%

χ^2 test statistic 18.985

p-value 0.04045 Reject Ho

A low p-value is evidence that the row and column attributes are NOT independent

Ho - Two attributes are independent

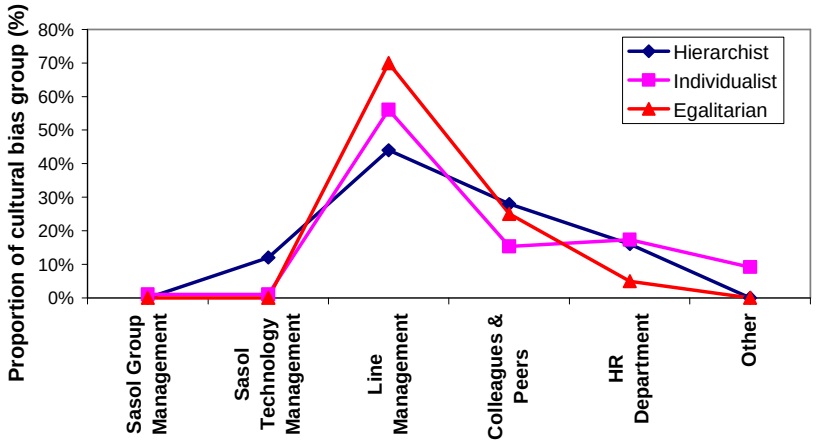
Ha - Two attributes are NOT independent

Observed percentages row totals

Hierarchist	Individualist	Egalitarian	
0%	100%	0%	100%
75%	25%	0%	100%
14%	69%	18%	100%
26%	56%	19%	100%
18%	77%	5%	100%
0%	100%	0%	100%

Graph for question 3.2.9

	Hierarchist	Individualist	Egalitarian
Sasol Group Management	0.0%	1.0%	0.0%
Sasol Technology Management	12.0%	1.0%	0.0%
Line Management	44.0%	56.1%	70.0%
Colleagues & Peers	28.0%	15.3%	25.0%
HR Department	16.0%	17.3%	5.0%
Other	0.0%	9.2%	0.0%



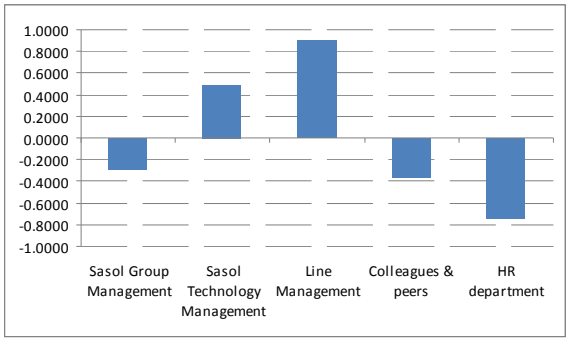
APPENDIX E: EXAMPLE OF DISTRIBUTION FITTING ALGORITHM INPUT AND OUTPUT

Question 3.5.1				Source			
	Cultural bias group	1	2	3	4	5	
	1 (Hierarchist)	Sasol Group Management	Sasol Technology Management	Line Management	Colleagues & peers	HR department	
Rank	1	1	5	9	0	1	16
	2	3	6	4	2	1	16
	3	4	3	2	5	2	16
	4	4	1	1	6	4	16
	5	4	1	0	3	8	16
		16	16	16	16	16	
		Proportions (input to Excel regression algorithm)					
		0.063	**0.313**	**0.563**	**0.000**	**0.063**	
		0.188	**0.375**	**0.250**	**0.125**	**0.063**	
		0.250	**0.188**	**0.125**	**0.313**	**0.125**	
		0.250	**0.063**	**0.063**	**0.375**	**0.250**	
		0.250	**0.063**	**0.000**	**0.188**	**0.500**	

Rank ordered data - Results

Item means

Sasol Group Management	Sasol Technology Management	Line Management	Colleagues & peers	HR department	Std Stdev	Mean	Vaiance of means	Mean Variance	Overall Variance
-0.4082	0.5673	1.0710	-0.4928	-0.9741		-0.047376669	0.56319107	1	1.540969
-0.2907	0.4952	0.9009	-0.3589	-0.7465	0.8056	4.44089E-17	0.365478556	0.648942	1.014421



APPENDIX F: EXAMPLE OF 2-WAY ANOVA (AFTER MONTGOMERY, 2001)

How key critical challenges impact my work environment	Sasol Group Management	Sasol Technology Management	Line Management	Colleagues & peers	HR department	Stdev	Sample size	y(i..)	Nr observations in i_{th} row, n(i.)	$y(i..)^2/n(i.)$	Mean for culture groups	Sample variances	Weights for pooled variance
Culture 1	-0.2948	0.4990	0.8992	-0.3574	-0.7459	0.8054	16	0.0000	80	0.0000	0.000	0.649	0.146
Culture 2	-0.0821	0.6581	0.8915	-0.4776	-0.9899	0.7233	79	0.0000	395	0.0000	0.000	0.523	0.727
Culture 3	-0.5071	0.5546	1.1482	-0.2616	-0.9340	0.6672	14	0.0000	70	0.0000	0.000	0.445	0.127
y(.j.)	-18.299	67.734	100.890	-47.116	-103.210								
Nr observations in j_{th} column, n(.j)	109	109	109	109	109								
$y(.j.)^2/n(.j)$	3	42	93	20	98		y(…)	0.000					
							n(..)	545					

Matrix to calcutate $y(ij.)^2/n(ij)$	Sasol Group Management	Sasol Technology Management	Line Management	Colleagues & peers	HR department
Culture 1	1.3909	3.9836	12.9358	2.0442	8.9008
Culture 2	0.5319	34.2106	62.7888	18.0237	77.4085
Culture 3	3.5998	4.3055	18.4559	0.9582	12.2136

Number of culture groups	3	a
Number of comminication sources	5	b
Total sample size	545	n(..) = abn
Grand mean	0.000	
Pooled variance	0.531	σ^2
Pooled standard deviation	0.729	

Source	SS		df		MS		F		p-value
Culture types	0.000	$\Sigma y(i..)^2/n(i.) - y(\ldots)^2/n(..)$	2	(a-1)	0.000	$SS_A/(a-1)$	0.000	MS_A/MS_E	1.0000
Source of communication	256.641	$\Sigma y(.j.)^2/n(.j) - y(\ldots)^2/n(..)$	4	(b-1)	64.160	$SS_B/(b-1)$	120.717	MS_B/MS_E	0.0000
Interaction	5.1106	$\Sigma\Sigma y(ij.)^2/n(ij) - y(\ldots)^2/n(..) - SS_A - SS_B$	8	(a-1)(b-1)	0.639	$SS_{AB}/((a-1)(b-1))$	1.202	MS_{AB}/MS_E	0.2955
Error	281.691	$\sigma^2 ab(n-1) = \sigma^2(abn-ab)$	530	ab(n-1) = abn-ab	0.531	$SS_E/(ab(n-1))$			
Total	543.443		544	abn-1					