R. Meredith Belbin's Team Roles Viewed From the Perspective of The Big 5

A Content Validation

Rolf Marvin Bøe Lindgren

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Abstract

The content validity of Belbin's Team Roles, as operationalized by the questionnaire accompanying his INTERPLACE expert system, was investigated. The approach taken to content validation was that advocated by Loevinger (1957). The adjectives which describe each Team Role was tabulated accoring to their Big 5 loadings, as assessed by the Abridged Big Five Descriptional Circumplex . Two sets of mappings from the Big 5 were constructed: one strictly adhering to the INTERPLACE operationalization, and one where the less important factors were pruned. Simulations show that Belbin's own operationalization of the Team Roles has poor discriminant validity because most of the Team Roles load on all of the factors of the Big 5. The re-interpretation mroe directly based on the Big 5 showed better psychometric properties and remained to a large extent true to Belbin's informal description of his Team Roles.

Chapter 1

Introduction

Teams at work

Many great achievements seem to be the product of the labor of a dedicated individual, such as Newton's and Einstein's physics, the music of Beethoven and Bach, Darwin's theory of evolution, or Skinner's theory of verbal behavior.

Even tho these past masters stood on 'Ye Shoulders of Giants,' they seem to have stood solitary, quite content with proceeding on their own.

Many other great achievements seem to have come by *due to* the collaboration of individuals who often differed markedly in personality, such as the team of Thomas Edison and Nikola Tesla, who pioneered electrical and in particular alternate current engineering; John Lennon and Paul McCartney, who together transformed popular music into an art form; Stephen Wozniak and Stephen Jobs, founders and early defectors of the Apple computer company. Domestic teams that come to mind are the chemical engineering entrepreneurs Christian Birkeland and Samuel Eyde; and Ole-Johan Dahl and Kristen Nygaard, co-inventors of the computer programming language, Simula, and originators of the object-oriented computer programming paradigm. Belbin (1981) provides further examples.

A person cannot be perfect, but a team can be, in the sense that a team might comprise personal attributes that no single person could ever contain. Personal attributes of several people making up a team might either complement each other, or have a synergetic effect.

In the case of Edison and Tesla, for instance, Tesla's introverted, sulking genius seems to have been made much more useful than it would otherwise have been, thru Edison's extroverted enthusiasm.

Likewise, Steve Wozniak was content with developing useful computer applications, and only reluctantly co-founded Apple with his collaborator, the visionary but unfortunately too eccentric Steve Jobs.

It seems, then, the talents of the solitary thinker who can wield great ideas, teamed up with the talents of the enthusiastic visionary who can turn ideas into reality, is a successful combination. These talents and personal characteristics are not common within a single individual, but can, of course, occur in a team of individuals.

Individuals in teams

For our purposes, a team is any number (greater than one) of individuals who share an expressed interest in working together in order to achieve a goal. A team, then, consists of individials, and as individuals they have a number of properties or attributes which determine their efficiacy as members of the team.

Clearly, working in teams brings out the beast in some people, if a suitable partner or set of partners can be found. Is it possible, tho, to *know* or to *predict with some non-trivial degree of accuracy* just how beneficial a team is?

At a fairly abstract level, I suggest that the factors which are of prime importance as regards the efficiency of an individual employed at a task, are the following:

- The task at hand
- Those with whom the individual will collaborate
- The individual's personal makeup, in particular
  - Intelligence
  - Skills
  - *Personality*

Most of these attributes are relatively unproblematic: If the task at hand is specified, establishing the sorts of skills needed and the minimum intelligence required should be fairly straigtforward. Brand (1994) suggests, in his lucid review of current intelligence research, that there is a strong positive correlation between intelligence and prodictivity.

Intelligence is usually operationalized as an IQ test score, and an individual's vocational competence can be assessed as a combination of education and relevant experience. However, it has been suggested that a team consisting of many exceptionally intelligent individuals will have inherent problems, something which would probably not have been noted if intelligence had only been studied at an individual level (Belbin, 1993b; Brand, 1994).

Furthermore, and presumably more trivially, the more any individual knows, the better; and the more comprehensive the entire team's shared kowledge is in relation to the task at hand, the better.

The difficult problem lies in determining how personality affects the efficiacy of the team.

In order to talk about personality, there must exist a way to describe it. A massive body of literature (John, 1990) suggests that personality can be described in terms of a small number of *traits*. A number of authors have suggested that combinations of these traits can be viewed as personality types (Jung, 1927/1971) or roles (Belbin, 1993b).

Thesis

R. Meredith Belbin's INTERPLACE expert system for determining Team Roles and building management teams based on its suggestions has been used extensively in England and other countries, and also in Norway. The INTERPLACE system is designed to single out which individuals will succesfully co-operate with other individuals.

Even tho the system promises a great deal, research shows that the validity of the personality test that is employed in connection with INTERPLACE is less than adequate. It correlates poorly with itself, with other measures of personality, and the research upon which it is based has never been published (Furnham, Steele and Pendleton, 1993).

During the last 15 years, the Big 5 has emerged as a leading suggested common framework for personality theories. Any theory of personality could, in principle, be expressed in terms of the Big 5. This has also been attempted as part of an empirical validation of Belbin's Team Roles (Broucek and Randell, 1996).

However, Loevinger (1957) argues that empirical validations are essentially *ad hoc* and argues that from a theoretical point of view, construct validity is all of validity. Attempting a construct validation from the perspective of the Big 5 readily suggests itself. The only operationalization of Belbin's Team Roles which is available are his assessment instrument, which is one natural starting point and the one chosen here.

Since Belbin's most recent questionnaire consists of a list of adjectives, a validation using these adjectives as a starting point can be made possible. As has been demonstrated by the Abridged Big Five Descriptional Circumplex (AB5C), most trait-describing adjectives can be described in terms of which of the Big 5 factors it loads on. This allows for a quite nuanced analysis of the terms by which Belbin's Team Roles are composed.

An informal inspection of the list of adjectives upon which Belbin's Team Roles seem to be operatoinalized suggests a possible explanation for the poor reviews which Belbin's tests has received. The Team Roles do not seem to be very distinct if viewed from the perspective of the Big 5. Each

individual role seems to be defined in terms of adjectives which together span over most if not all of the Big 5. This would mean that most individuals have *some* of what it takes to be *any* role. This operationalization, then, introduces a lack of distinctness (low discriminant validity).

Furthermore, such an analysis would help spot contradictions of the operationalization relative to the Big 5. A contradiction in this sense occurs when two adjectives which loads in opposite directions on one of the five factors are used to describe the same Team Role.

A way of creating a better operatinalization of Belbin's Team Roles would be to define the Team Roles in terms of only those adjectives which seem to be the most significant or important of Belbin's operationalization. This would ensure a high level of distinctness of the roles.

In this thesis, then, the following will be attempted:

- to validate theoretically Belbin's Team Roles based on the AB5C interpretation of the Big 5
- to construct an improved operatinalization of a set of Team Roles based on the Big 5 and inspired by Belbin's publications

Chapter 2

The case for personality taxonomies

An objection against creating personality taxonomies which has been voiced even by the research staff at the University of Oslo is that taxonomies

- ignore the richness of human life
- are generally questionable because they imply a stability of personality which is not supported by research

Therefore, I would like to briefly discuss the utility and validity of personality taxonomies.

Taxonomizing personality as a means of increasing control

Humans live in societies and depend on each other in their daily lives. Both in work and play, humans typically encounter a large number of individuals. A psychology student, for instance, on a day–to–day basis socializes and works with 35 class–mates, 10–15 professors and teachers, other students, their friends, family, clerks, civil servants, etc. Treating each and every one of them as a unique individual with nothing in common with other people seems very uneconomical. If it is possible to assume that two individuals who possess certain mutual characteristics also must possess other, similar characteristics, then it is possible to predict and describe behavior of unfamiliar individuals by contrasting and comparing them with familiar individuals.

Furhtermore, being able to predict other people's behavior should have some survival value. Even if one's life does not necessarily depend on the ability to correctly predict large–scale human behavior, human's ability to predict or classify other people's behavior on a day–to–day basis should reasonably carry some degree of accuracy.

Personality taxonomies, then, ought to be useful in any society where it is possibe to gain an advantage by being quick at forming correct impressions of other people.

If one does not allow oneself to form taxonomies, i.e. to assume that individual characteristics somehow go together, one runs the adverse risk: since it is beyond anybody's abilities to take the idiosyncracies of all individuals into account, one may economize by focusing on what everybody has in common, thus losing *all* individual variation.

Taxonomy, then, at best is a compromise between maintaing absolute complexity and absolute simplicity.

Taxonomizing personality as a means of reducing anxiety

All humans need a certain degree of stability in order to function adequately. Lack of stability creates a more or less unpleasant feeling of anxiety.

Many human endeavors can be viewed as means to escape this anxiety, from the development of culture itself (Pyszczynski, Greenberg, Solomon and Hamilton, 1991) to the development and

maintenance of mental disturbances (Anderson and Goolishian, 1992). Jean-Paul Sartre's vision of Hell (Sartre, 1955) is a place where nothing ever can be anticipated in advance, and where everything is constantly changeing, including the nature of change: in Sartre's hell, not even change is consistent.

Bringing about change in individuals is very difficult. Deviating from one's chosen path creates anxiety, because the end result of change is uncertain. Additionally, humans seek out familiar environments, and actively try to increase the familiarity of their environments (Bowlby, 1988).

The consistence of personality

Individuals differ, but there is consistency to the way in which individuals differ. This basic knowledge enables us to enumerate and categorize those individual differences that play the significant parts in communication and cooperation between individuals.

Is is reasonable, then, to assume that humans

- try to remain stable individuals
- look for stabilty in others

Even if it is the case that humans try to maintain consistency of their own behavior, it is still not guaranteed that the stability which humans observe in others is real. Mischel (1968) goes so far as to postulate that the consistency of behavior which humans report of themselves and others is an illusion, imposed upon the world due to a need for consistency which does not actually exist. In other words, even if it is correct that human behavior does have a non–trivial degree of consistency and predictabiliy there is no guarantee against biases and attribution errors in interhuman observation.

Ross and Nisbett (1991), in their re–appreciation of Mischel (1968) in fact, argue that even tho indivuduals can be expected to over–attribute acts of individuals to personal dispositions, there is sufficient evidence to conclude that cross–situational consistency of behavior is very much real.

Pervin (1994) reiterates Mischel (1968) arguments, arguing that cross–situational consistency of behavior still suffers from low predictability. Funder (1994) expresses surprise over such a charge:

> If there were one issue aldready dealt with elsewhere and years ago, one could be forgiven for thinking this was it. Trait measures can be used to predict behavior, [...] Nobody disputes this anymore, so far as I am aware, and that fact is perhaps one of the major concrete advances "soft" psychology can report over the last two decades (*ibid., p 125*).

Chapter 3

The Big 5

Introduction

In this section, the five factors of the Big 5 are presented. There are 4 purposes of this presentation:

1. to draw a distinction between a descriptive and a phenomenological approach to personality taxonomy
2. to demonstrate that the five factors provide actual distinctions between individuals
3. to provide a basis for a typology based on traits
4. to show that there are positive aspects to both extremes of each factor.

Roles, Types or Traits?

Roles

A standard textbook on social psychology defines the term *role* as

> a set of behaviours associated with a position (Hewstone, Stroebe, Codol and Stephenson, 1988, p. 455).

R. Meredith Belbin defines the term *Team Role* as

> [...] a pattern of behavior characteristic of the way in which one team member interacts with another where his performance serves to facilitate the progress of the team as a whole. (Belbin, 1981, p. 169)

Belbin's usage of the term 'Team Role' deviates, then, from the way the term is commonly used in social psychology. One is, in general, said to play a role when one exhibits behavior associated with constraints assigned by the outside world relative to one's position: judge, doctor, dope peddler are *roles* in a social psychological sense. The team roles are *not* roles in this sense. *Team Member* might be said to be a role; then Belbin's Team Roles might be said to comprise different ways in which different individuals would play the role of *Team Member*.

The names and descriptions of his Team Roles vary slightly from book to book. Here, the descriptions used in Belbin (1993b) will be used unless otherwise noted. Belbin (1993b) provides lengthy elaborations and brief descriptions of the Team Roles. One such description (Belbin, 1993b, p. 51) is as follows:

Team Role		*Weaknesses*	
		Allowable	*Not allowable*
Plant	Creative, imaginative, unorthodox. Solves difficult problems.	Preoccupation with ideas and neglect of practical matters	Strong 'ownership' of id co-operation with other have yielded better resu
Resource Investigator	Extrovert, enthusiastic, communicative. Explores opportunities. Develops contacts.	Loss of enthusiasm once initial excitement has passed	Letting clients down by neglecting to follow-up arrangements
Co-ordinator	Mature, confident. A good chairperson. Clarifies goals, promotes decision-making, delegates well.	An inclination to be lazy if someone else can be found to do the work	Taking credit for the eff team
Shaper	Challenging, dynamic, thrives on pressure. Has the drive and courage to overcome obstacles.	A proneness to frustration and irritation	Inability to recover from with good humor or ap
Monitor/Evaluator	Sober, strategic and discerning. Sees all options. Judges accurately.	Sceptisism without logic	Cynicism without logic
Team Worker	Co-operative, mild, perceptive and diplomatic. Listens, builds, averts friction. Calms the water.	Indecision on crucial issues	Avoiding situations that entail pressure
Implementor	Disciplined, reliable, conservative and efficient. Turns ideas into practical actions.	Adherence to the orthodox and unproven	Obstructing a change
Completer/Finisher	Painstaking, conscientious, anxious. Searches out errors and ommisions. Delivers on time.	Perfectionism	Obsessional behaviour
Specialist	Single-minded, self-staring, dedicated. Provides knowledge and skill in rare supply	Aquiring knowledge for its own sake	Ignoring areas outside o of competence

Traits

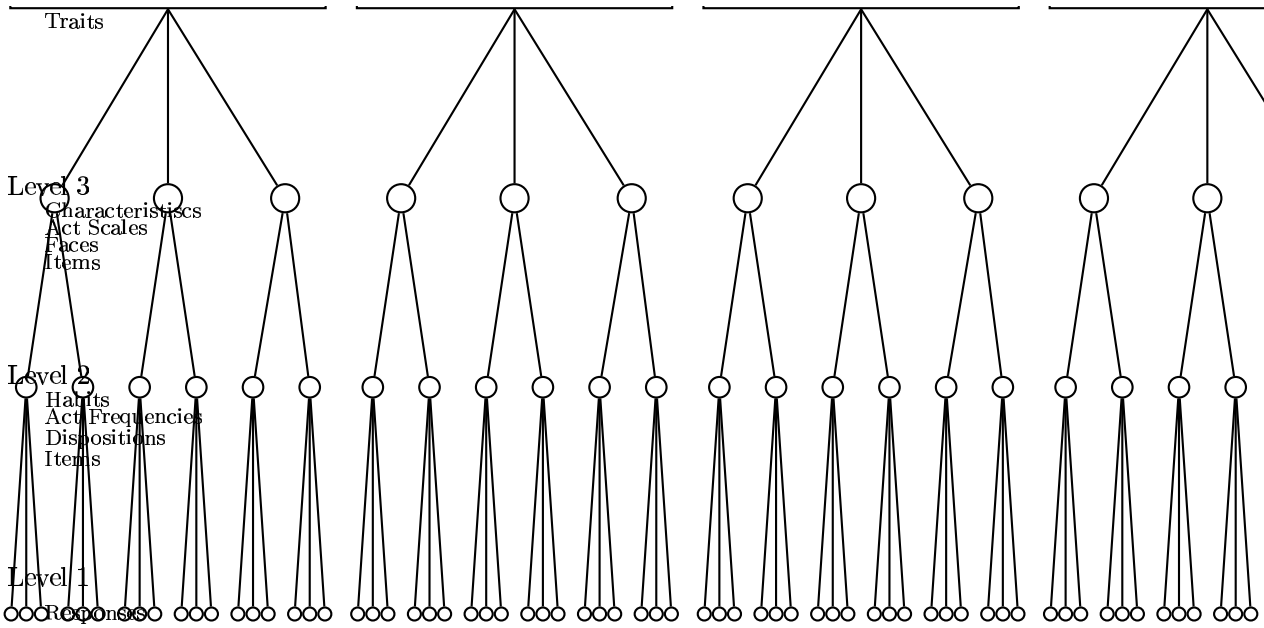
The major proponents of the Big 5 seem to view personality as a set of *traits*.

A trait is a personality characteristic which is realtively stable over time and across situations (Saucier and Goldberg, 1996a), or a disposition to behave in a particular way as expressed in a person's behavior over a range of situations (Pervin, 1989).

The trait approach seems to come quite natural to man, as suggested by the existence of 5000 trait-describing adjectives. People habitually describe people in terms of traits.

Digman (1990) describes four levels of abstraction of behavior (see figure 3.1 on the following page). At the basic level are those responses which specific to specific situations. At a higher level of abstraction are those responses which are typically made to prototypic situations. At an even higher level of abstraction are behavior aggregates or questionnaire items. At the fourth and highest level are the Big 5.

Digman (1990) seems to call the Big 5 factors *traits*. I would like to reserve the term *trait* to those behavioral items which are relatively stable across situations, which would be about equivalent to the second level of abstraction. The Big 5 personality dimensions are collections of traits, usually


Traits
Level 3
Characteristics
Act Scales
Faces
Items
Level 2
Habits
Act Frequencies
Dispositions
Items
Level 1
Responses

found by factor analyses of peer-ratings using trait-describing adjectives. The terms at the level of abstraction at which the Big 5 resides are more properly called *factors* or *dimensions*.

Trait-oriented personality tests, such as those which measure the Big 5 personality dimensions, usually express their scores as T-scores. T-scores are normally distributed, have a mean of 50 and a standard deviation of 10 (In contrast, e.g. IQ-scores have a mean of 100 and usually a standard deviation of 15).

Types

In contrast to traits, Jung (1927/1971) employed a model where one personality *orientation* and two *mental functions* where dicothomized, giving eight possible combinations or personality types. A type, then, would be anybody who preferred one particular set of orientations to all of the others. Here, strength of preference plays a minor role, what matters is the *direction* of preference.

In Jung (1927/1971), each type is viewed as a description that is *true* in the sense that an individual's type accurately describes the preferred characteristic behavior of the individual; deviance from this general behavior is, in general, forced upon the individual and is perceived as stressful and undesirable. A person's type is relatively fixed: the environment only plays a role to the extent that it allows the individual to live his or her preferred type.

Both the Jungian dimensions and the personality descriptions of the Big 5 are held to be semantically *orthogonal*. However, the factors of the Big 5 are considered quite broad. One might imagine, then, personality types which can be contained within a single trait. For some situations, such types might even be useful within some context.

It appears, tho, that as far as Belbin's Team Roles are concerned, this is not the case. All of the Team Roles have been explained as composites of the Big 5 (Broucek and Randell, 1996). There is no guarantee, however, that there might not emerge Team Roles which *can* be explained in terms of subscales of just one factor.

The Lexical Hypothesis

Gordon W. Allport and H. S. Odbert theorized that if traits exist, then useful traits are represented in the language. They extracted personality-relevant words from the 1925 edition of Webster's New International Dictionary. The extraction criterion was ability to distinguish the behavior of one human being from that of another. With the addition of a few slang terms, the initial list contained approximately 18,000 words: 1/4 of these were trait descriptors.

These trait-describing adjectives were classified into four categories. The first one "contained terms that designate possible personal traits and are relatively neutral in their evaluation" (John, 1990). The other three categories were

- descriptions of temporary states, moods, and activities
- evaluative terms, such as 'insignificant' and 'worthy'
- miscellaneous terms of little relevance to personality

This first, classical attempt at a descriptive taxonomy, then, resulted in four alphabetical listings of personality-describing terms. Subsequent lexical analyses have consentrated on the first list, i.e. on terms describing realtively stable personality dispositions. The absence of evaluative terms is noteworthy: words describing *intimacy*, such as 'sexy,' would possibly be left out.

Beginning in 1943, Raymond Cattell performed a factor-analytic study of peer ratings primarily based on the first Allport-Odbert list. However, he added 100 terms from the second list, he removed words which he felt were archaic or unfamiliar, and had to resort to several shortcuts due to the limited computing power of the time.

Cattell claimed that 'the analysis into clusters was made entirely blind, on mathematical criteria only.' (John, 1990). However, he must have resorted to subjective judgements in both in selecting the

terms and in choosing mathematical methods (*ibid.*), so his judgement must have played an important part in obtaining his results.

Cattell reported sixteen personality factors, which were used as a basis for his 16PF personality inventory. (John, 1990; Digman, 1990). However, even tho Cattell stated that he had derived his factors theoretically, replications of his study has not derived the same number of factors (John, 1990).

Cattell's was only one of the first major attempt at constructing a personality taxonomy based on the lexical hypothesis. John (1990) lists 14 major attempts prior to 1980, a year which marks a turning point.

The search for a useful number of factors was partly guided by the fact that Cattell reported 16, and a general idea that personality is too complex to be captured by a number much smaller than this. At a symposium held in Honolulu in 1980 during a convention of the Western Psychological Association, four prominent researchers (Lewis Goldberg, Naomi Takamoto-Chock, Andrew Comrey, and John M. Digman) decided to accept that the five-factor solution which seemed most common was, in fact, correct (Digman, 1996). The five factors were probably first called the 'Big 5' by Goldberg in 1981 (John, 1990). The name indicates that the factors are broad and summarize a large number of distinct traits.

Hence the tradition of refering to the factors by their numbers according to their relative importance (John, 1990). In the following, I will refer to the factors according to the standard convention of numbering them according to their apparent relative importance.

I	II	III	IV	V
aggressive	accomodating	careful	unenvious	artistic
assertive	aquiescent	efficient	calm	complex
daring	compassionate	exacting		creative
extraverted	cordial	fasticious		imaginative
flamboyant	kind	fussy, tidy		philosophical
frank, open	mild, gentle	hardworking		
fun loving	sincere	meticulous		
outspoken	softhearted	neat		
sociable	sympathetic	orderly		
straightforward				

Table 3.1: Five factors and corresponding trait-describing adjectives (From Johnson and Ostendorf (1993), Hofstee *et al.* (1992), Saucier and Goldberg (1996a))

An example of a combination of the trait and the type approach

A broad characteristic description of an individual can be obtained from a reading of the individual scores on each particular trait, as provided by a stanrad personality test. As an example, a random description of the individual John H. Doe might read:

Mr. Doe is a highly conscientious and a very uptight individual, probably suitable for any task where one cannot be fussy enough. His most extreme scores are on Factor III and factor IV.

According to Belbin (1993b), the Completer/Finisher (see table 4.5 on page 32) is *painstaking*, *conscientious*, and *anxious*, which is certainly the case for Mr. Doe. Other roles which are close in description to this character is the *disciplined* and *reliable* Implementor, and the *accurately* judging Monitor/Evaluator.

If personality traits are basic units of behavior, while Team Roles are emergent, observable behavior, then a mapping from traits to Team Roles should be feasible. If the Big 5 provides a general framework which describes the vast majority of individuals, and if there is merit to the tram role

Factor	Description	Score
I	Extroversion	49
II	Agreeableness	63
III	Conscientiousness	81
IV	Neuroticism	33
V	Openness to Experience	60

Table 3.2: John H. Doe's personality profile

concept, then it should be possible to construct a mapping from the Big 5 to some team-role system.

There exists one obvious starting point in a mapping from the Big 5 to Belbin's Team Roles. The INTERPLACE system, which is a computer-assisted tool for assessing Team Roles, can be viewed as an operationalization of Belbin's team-roles. The 'Observer's Assesments Sheet,' which is part of INTERPLACE, can be viewed as a mapping from personal descriptions to Team Roles. Most of these are adjectives, as used in the lexical tradition which constitutes the Big 5.

An inspection of all of the adjectives, then, might provide the framework of a set of hypotheses regarding the Big 5 loadings of each Team Role. A remaining problem, of course, is to decide which adjectives map to which Team Role.

The Abridged Big 5 Dimensional Circumplex

Many trait-describing adjectives are not factorially clean, i.e. they load, or refer to, more than one factor. This can lead to confusion:

- If a trait is described in terms of adjectives that have a secondary loading on the same factor, its flavor will be different than if it had been described in terms of adjectives that have a secondary loading on another factor.
- If an adjective has about the same loading on two factors, one report might conclude that it belongs to one of the factors while another report might conclude that it belongs to another factor.

One way to go about this problem is called the AB5C, which is a method useful for displaying and examining the relation, if any, between the factor loadings of a trait-describing adjective.

The procedure consists of obtaining self-descriptions and peer-descriptions of subjects using trait-describing adjectives from a given list. The next step is to factor-analyze the findings, and to plot the resulting factors according to their loadings on a two-dimensional surface or *circumplex*.

The recommended method (Hofstee *et al.*, 1992) uses circles partitioned into 12 segments of equal size. The extent to which a a trait is represented by the model is indexed by the length of its projection on the bisectrix of the segment. The projection length is

$$h = a_1 \cos(30^\circ) + a_2 \cos(60^\circ)$$

where a_1 and a_2 are the absolute values of the primary and secondary loadings.

Variables below a certain threshold are omitted. This ensures that only factors with substantial loadings more than two factors are pruned.

The circle is divided into 12 segments because each segment covers all 12 possible permutations of two-factor labels. This is illustrated in figure 3 on the following page.

As an example, the adjective *domineering* has a primary loading of .43 on factor I and $-.29$ on factor II. The projection length would be

$$h = .43 \times 0.866 + .29 \times 0.5 = .52$$

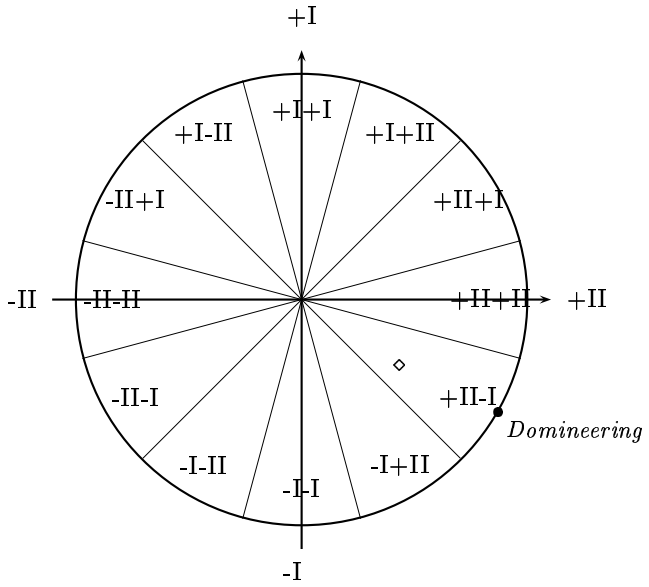


Figure 3.2: The AB5C interpretation of domineering

and the position of *domineering* on a circumplex of factor I and II is as displayed on figure 3.

The circumplex approach is suitbale for a range of applications where it is desirable to examine the relationship, if any, between two dimensional variables.

Wiggins and Trapnell (1996) have investigated the suggestion that the metaconcepts of *agency* and *communion* 'characterize two fundamental modalities in the existence of living forms.' (*ibid*, p. 90). In their approach, *agency* is taken to be captured by factor I while *communion* is captured by factor II (p. 134).

A profile of an individual might be displayed as that individual's profile as obtained by plotting his or her test responses on the circle showed in figure 3 on the following page.

Here, 0° is at the Warm/Agreeable pole, 90° at the Assured/Dominant pole, 180° at the Cold-hearted pole and 270° at the Unassumed/Submissive pole.

In the example on page 3.2 on the page before, John H. Doe has a score of 49 on factor I and 63 on factor II. This makes him a +II+II individual, and places him at the top of the bottom right quadrant, clearly at the Warm/Agreeable pole.

In a series of articles in the domestic tabloid newspaper Dagbladet, psychologists Per Carlenius and Sigurd Stubsjøen wrote about *emosjonell intelligens (EQ)* (Goleman, 1996), indicating that

> At its most advanced level, EQ takes part in empowering one to discover and to symbolize complex and higly differentiated sets of emotions and to impart a deep knowledge of life's emotions.
>
> [...]
>
> Emotional intelligence is something else and something more than social competence. Social competence is usually associated with gregariousness, self-confidence, low anxiety and an ability to pick up social cues. Even tho there is a connection with both general intelligence and emotional intelligence there exists a clear difference. Social competence refers to a variety of personality traits, but a trait is just a preference for a behavior and not an ability. Knowing, in contrast, what somebody else feels is a mental skill. (Carlenius and Stubsjøen, 1997, my translation).

Using a circumplex approach, Moxnes and Engvik (1973/74) plotted individuals relative to their scores on factor I (will) and factor I (love). They showed that peer-ratings and self-ratings were closest

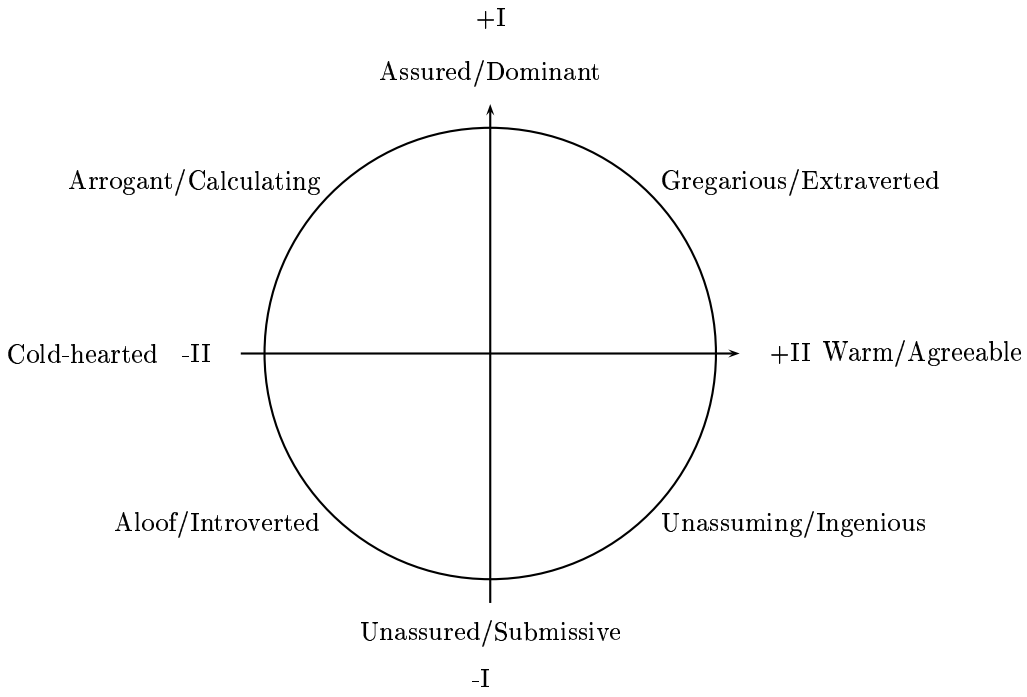


Figure 3.3: The Big 5 and the Interpersonal Space (adapted from (Wiggins and Trapnell, 1996)).

for those individuals who were judged by their peers to score in the upper right quadrant, i.e. high on both factor I and factor II.

EQ as described by Carlenius and Stubsjøen (1997) is more complex than a *preference* towards intersocial action. The theory of emotional intelligence derives much of its theoretical basis from Gardner's theory of *multiple intelligences* (Gardner, 1983). In his view, intelligences are multiple, including such intelligences as spatial, musical, bodily-kinestethic, inter- and intrapersonal intelligence, etc.

It seems reasonable to assume that Moxnes and Engvik (1973/74) findings suggest that high scores on factors I and II indicate self-insight, which is an important aspect of EQ, and that if there is a connection between personality and emotional intelligence, this may be where it is.

Incorporating results from the AB5C into an interpretation of Belbin's Team Roles

Belbin operarationalizes his Team Roles in terms of sets of adjectives. It seems natural, then, to investigate these adjectives' Big 5 loadings. The primary loadings, however, do not tell the entire truth about how a test respondent will typically relate to the adjectives. An investigation of the secondary loadings will reveal more of the full picture.

Investiagtions done during the last decade have provided lists of primary and secondary loadings of a large number of adjectives. Three studies have provieded 711 adjectives, not excluding doubles. These lists were used as a basis for tabulating the primary and secondary loadings of Belbin's adjectives.

The following tables show in detail the 72 adjectives used in describing Belbin's Team Roles.

The first rows show each adjectives and how various investigators have assessed their loadings. The next rows show the loadings I have assumed to be right.

Some assumptions have had to be made because not all adjectives were covered, and some adjectives were reported differently (but usually not very much so) by different sources. The gaps were filled in by an individual familiar with the Big 5 (FFM) and I. A list of the adjectives not covered was

tabulated, and separately assessed by us. Our result were compared and finally used in the tabulation.

The final row of each table shows the sums of the occurences of factors of the second set of rows, a total of 16 in each case. In some cases one factor is represented by the same amount of pluses and minuses (e.g. 2 × +I, 2 × -I). For clarity, these have not been cancelled out.

For simplicity, I have given the same weight to secondary and primary factors. Doing otherwise would assume a level of precision not present in the study. The result should be taken as an *indication* of the distribution of factor loadings in Belbin's operationalization, not as a precise assessment.

These results were later used to simulate the distibution of Team Roles which would result in a normal population, if the FFM factor loadings found to be present in Belbin's operationalization is reflected in his test.

They were also used to identify which factors are most important of each Team Role, in order to create an operatipnalization where the least important factors are pruned.

Belbin's Team Roles tabulated according to their loadings relative to the AB5C

Sources:

1 Johnson and Ostendorf (1993)
2 Harald Engvik and I
3 Hofstee *et al.* (1992)
4 Saucier and Goldberg (1996b)

Adjective	Loading	Source	Note
adaptable	+II+IV	1	cooperative, flexible, forgiving
	+IV+IV	2	
caring	+II+III	1	empathic, kind, helpful
	+II+II	2	
co-operative	+II+IV	1	
	+II+III	3	
	+II+II	4	
diplomatic	+II-I	1	
	+V+II	3	
observant	+V+III	1	perceptive
	+V+III	3	perceptive
	+V+V	4	
fearful of conflict	-I-IV	3	cowardly, guarded, secretive
	-IV+II		
indecisive	-III-I	3	
	-III-III	4	
over-sensitive	-II-IV	1	irritable, moody
	-IV-IV	2	

adaptable	+IV+IV
caring	+II+II
fearful of conflict	-IV+II
observant	+V+V
co-operative	+II+III
diplomatic	+II-I
over-sensitive	-IV-IV
indecisive	-III-I

Function:	2 × -I, 5 × +II, +III, -III, 2 × +IV,3 × -IV, 2 × +V

Table 3.3: Team worker

Adjective	Loading	Source	Note
broad in outlook	+V+III	1	broad interests, knowledgable, perceptive
	+V+V	2	
calm & confident			
	+IV+Iv	2	
calm	+IV+IV	1	
confident	+IV+I	1	
	+I+IV	3	
	+I+IV	4	
conscious of priorities	+III+IV	3	thorough, consistent, logical
	+III+IV	1	self-disciplined, persevering, well-read
	+III+III	2	
consultative	+II+III	1	helpful
	+II+III	3	helpful
	+II+II	2	
encouraging of others	+II+III	1	empatchic, helpful
	+II+III	3	helpful, cooperative
	+II+II		
empire-building	+I+III	1	? enterprising
	+I	2	
laid-back	-III+II	1	? easy-going
	+IV	2	
manipulative	-I-I	1	
	-II+I	3	

broad in outlook	+V+V
calm & confident	+IV+IV
conscious of priorities	+III+IV
consultative	+II+II
empire-building	+I+I
laid-back	+IV-III
encouraging of others	+II+II
manipulative	-II+I

Function: 3 × +I, -II, 4 × +II, -III, +III, 4 × +IV, 2 × +V

Table 3.4: co-ordinator

Adjective	Loading	Source	Note
analytic	+V+III	1	analytical
	+V+III	3	analytical
	+V+V	4	analytical
impartial	-I+IV	3	
logical	+III+IV	3	
logical	+III+III	4	
realistic	-V-V	1	? down-to-earth
	-II+I	2	
shrewd	-II+V	3	*slu*
shrewd	-II+V	4	
critical	-II+V	1	
critical	-II-IV	4	
skeptical	-I-II	3	
slow-moving	-III+II	1	easy-going
	-I-I	2	
analytic	+V+III		
impartial	-I+IV		
logical	+III+IV		
realistic	-II+I		
shrewd	-II+V		
critical	-II+V		
skeptical	-I-II		
slow-moving	-I-I		
Function:	+I,4 × -I, 4 × -II, 2 × +III, 2 × +IV, 3 × +V		

Table 3.5: monitor/evaluator

Adjective	Loading	Source	Note
creative	+V+V	1	
	+V+V	3	
imaginative	+V+V	1	
	+V+V	3	
innovative	+V+IV	3	
	+V+V	4	
knowledgeable	+V+III	3	
	+V+V	4	
original	+V+I	3	+I is contrary to Belbin's description
forgetful	-III-IV	3	
	-III-III	4	
	+I-IV	2	
unorthodox	+V-III	1	
up in the clouds	+V+V	3	? complex, philosophical
	+V+I	2	
creative	+V+V		
forgetful	-III-IV		
imaginative	+V+V		
innovative	+V+V		
knowledgeable	+V+V		
original	+V+I		
unorthodox	+V-III		
up in the clouds	+V+I		
Function:	+I,-I, 2×-III, -IV, 11 × +V		

Table 3.6: plant

Adjective	Loading	Source	Note
accurate	+III+III	2	
conscientious	+III+II	1	
	+III+II	3	
	+II+III*	4	
good at following through	+III+IV	1	
	+III+IV	3	persevering, self-disciplined
	+III+III	2	
perfectionist	+III+V	1	
	+III+V	3	perfectionistic
	+III+III*	4	perfectionistic
persistent	+I+III	3	
frightened of failure	+I+III	1	competitive
	-IV-I	3	insecure, nervous, fearful
	-IV-I	2	
fussy	+III+III	1	
reluctant to delegate	-II-III	1	distrustful
	-II-IV	3	distrustful
	-III-IV	2	

accurate	+III+III
conscientious	+III+II
firghtened of failure	-IV-I
good at following through	+III+III
perfectionist	+III+V
reluctant to delegate	-III-IV
persistent	+IIII
fussy	+III+III

Function:	+I, -I, +II, 9 × +III, -III, 2 × -IV, +V

Table 3.7: completer/finisher

Adjective	Loading	Source	Note
disciplined	+III+IV	1	self-disciplined
	+III+IV	3	self-disciplined
	+III+III	4	self-disciplined
effective	+III+III	1	efficient
	+III+I	2	
loyal	+II+III	3	
	+II+II	4	
practical	+III+IV	1	
	+III+III	3	
	+III+III	4	
well organised	+III+V	1	
	+III+III	3	Organized
	+III+III	4	Organized
inflexible	-II-IV	1	inflexible or stubborn
resistant tochange	-II-IV	1	inflexible or stubborn
	-V-V	2	
unadventurous	-I-V	1	
	-I-V	3	
	-I-I	4	

disciplined	+III+IV
effective	+III+I
loyal	+II+III
practical	+III+III
resistant to change	-V-V
well organized	+III+III
inflexible	-II-IV
unadventurous	-I-V

Function: -I, +I,+II,-II,7 × +III, +IV, -IV, 3 × -V

Table 3.8: implementor

Adjective	Loading	Source	Note
challengeing	+I+I	3	aggressive, daring
	+I+I	2	
competitive	+I+III	3	
	+I+I	4	
hard-driving	+IV+I	3	indefatigable, weariless
	+I+III	2	
outspoken	-II+I	1	
	+I+I	3	
	+I+I	4	
tough	-II+I	1	proud, outspoken
	+I-II	3	domineering, bossy, forceful
	+I-II	1	dominant
	-II-II	4	
aggressive	+I+I	3	
	+I-II	4	
impatient	-II-IV	1	
	-IV-II	1	
	-IV-II	3	
	-IV-IV	4	
provocative	+I+I	? challengeing, aggressive, daring	
	-II+I	2	

challengeing	+I+I
competitive	+I+I
hard-driving	+I+III
outspoken	+I+I
provocative	-II+I
tough	-II-II
agressive	+I-II
impatient	-IV-II

Function: 9 × +I, 5 × -II, +III, -IV

Table 3.9: shaper

Adjective	Loading	Source	Note
enterprising	+I+III	1	
inquisitive	+V+I	3	
	+V+V	4	
opportunistic	+I+V	3	
	+I+I	4	
outgoing	+I+IV	1	
persuasive	+I+IV	?	
	+I+I	2	
easily bored	+V+I	?	
	+I	2	
erratic	-III-IV	3	*uforutsigbar*
	-III-III	4	
impulsive	-III-IV	3	
	-III-III	4	

easily bored	+I
enterprising	+I+III
inquisitive	+V+I
opportunistic	+I+V
persuasive	+I+I
outgoing	+I+IV
erratic	-III-III
impulsive	-III-III

Function: $7 \times$ +I, +III, $4 \times$ -III, +IV, $2 \times$ +V

Table 3.10: resource investigator

Adjective	Loading	Source	Note
clever	+III+V	1	
	+V+V	4	
professionally dedicated	-II-V	1	narrow-minded
	-II-V	3	narrow-minded
	+III+III	2	
self-reliant	+IV+III	1	
single-minded	-II-V	1	narrow-minded
	-II-V	3	narrow-minded
	-V+III		
technically skillful	???		???
	+III+III	2	
insular	-II-V	1	narrow-minded
	-II-V	3	narrow-minded
	-V-V	2	
not interested in others	-I-I	1	retiring, reclusive, unsociable, or solitary
	-I-I	3	withdrawn, introverted
	-II-II	2	
territorial	-II-IV	1	selfish, distrustful
	+III+I	2	

not interested in others	-II-II
insular	-V-V
professionally dedicated	+III+III
single-minded	-V+III
technically skillful	+III+III
clever	+III+V
territorial	+III+I
self-reliant	+IV+III

Function: +I, 2 × -II, 8 × +III, +IV, -IV, V, 2 × -V

Table 3.11: specialist

The construction of a basis for Team Roles

Having found, then, a way to translate adjectives describing Belbin's Team Roles into equivalent Big 5 factors, several options arise in constructing a new set of Team Roles.

One option is to translate strictly Belbin's Team Roles into Big 5 equivalents. This approach could lead to an alternative Team Role model, where Team Roles are expressed in Big 5 traits. Another option is to use Belbin's and, optionally, other theories similarily constructed, as a starting ground towards a set of roles more directly based on the Big 5.

This still leaves the option of whether to create a set of descriptions directly based on Big 5 factors, or to describe Team Roles in terms of Big 5 traits.

The approach behind this attempt is based on the idea that if the least important Big 5 factors of which a Team Role is composed are pruned, then what remains is a description which embraces the essential characteristics of that role.

If most individuals scores are close to average on most traits, it's reasonable to assume that in general, no more than two traits will be extreme in any one individual. The two most extreme scores are the most important ones, because these show where the individual differs from the mean. In keeping with Jung's (Jung, 1927/1971) suggestion that only few traits will be developed in any one individual, I assume that most individuals will have preference for at most two factors. The reasoning behind this is that people tend to develop their most prominent traits at the expense of the usage and development of the remaining traits.

Chapter 4

Theories of personality

Carl Gustav Jung

Carl Gustav Jung is probably most noted for his theory of the unconscious. This theory is beyond the scope of the present work. He, however, also formulated a theory of personality and of variations in personality which, perhaps contrary to the bulk of the rest of his work, can be operationalized and can therefore be subject to scientific study (McGowan, 1995).

Jung worked as a psychiatrist at the Burghölzli Psychiatric Hospital in Zürich.

MBTI

The Myers-Briggs Type Indicator (MBTI) (Briggs-Myers and McCaulley, 1985) is probably the most widely used personality inventory in the world. it is based on the theory of personality outlined in (Jung, 1927/1971), but differs in a variety of ways.

Belbin's Team Roles tabulated according to their loadings relative to the AB5C

Sources:

1 Johnson and Ostendorf (1993)
2 Harald Engvik and I
3 Hofstee *et al.* (1992)
4 Saucier and Goldberg (1996b)

Adjective	Loading	Source	Note
adaptable	+II+IV	1	cooperative, flexible, forgiving
	+IV+IV	2	
caring	+II+III	1	empathic, kind, helpful
	+II+II	2	
co-operative	+II+IV	1	
	+II+III	3	
	+II+II	4	
diplomatic	+II-I	1	
	+V+II	3	
observant	+V+III	1	perceptive
	+V+III	3	perceptive
	+V+V	4	
fearful of conflict	-I-IV	3	cowardly, guarded, secretive
	-IV+II		
indecisive	-III-I	3	
	-III-III	4	
over-sensitive	-II-IV	1	irritable, moody
	-IV-IV	2	

adaptable	+IV+IV
caring	+II+II
fearful of conflict	-IV+II
observant	+V+V
co-operative	+II+III
diplomatic	+II-I
over-sensitive	-IV-IV
indecisive	-III-I

Function:	2 × -I, 5 × +II, +III, -III, 2 × +IV,3 × -IV, 2 × +V

Table 4.1: Team worker

Adjective	Loading	Source	Note
broad in outlook	+V+III	1	broad interests, knowledgable, perceptive
	+V+V	2	
calm & confident			
	+IV+Iv	2	
calm	+IV+IV	1	
confident	+IV+I	1	
	+I+IV	3	
	+I+IV	4	
conscious of priorities	+III+IV	3	thorough, consistent, logical
	+III+IV	1	self-disciplined, persevering, well-read
	+III+III	2	
consultative	+II+III	1	helpful
	+II+III	3	helpful
	+II+II	2	
encouraging of others	+II+III	1	empatchic, helpful
	+II+III	3	helpful, cooperative
	+II+II		
empire-building	+I+III	1	? enterprising
	+I	2	
laid-back	-III+II	1	? easy-going
	+IV	2	
manipulative	-I-I	1	
	-II+I	3	

broad in outlook	+V+V
calm & confident	+IV+IV
conscious of priorities	+III+IV
consultative	+II+II
empire-building	+I+I
laid-back	+IV-III
encouraging of others	+II+II
manipulative	-II+I

Function: 3 × +I, -II, 4 × +II, -III, +III, 4 × +IV, 2 × +V

Table 4.2: co-ordinator

Adjective	Loading	Source	Note
analytic	+V+III	1	analytical
	+V+III	3	analytical
	+V+V	4	analytical
impartial	-I+IV	3	
logical	+III+IV	3	
logical	+III+III	4	
realistic	-V-V	1	? down-to-earth
	-II+I	2	
shrewd	-II+V	3	*slu*
shrewd	-II+V	4	
critical	-II+V	1	
critical	-II-IV	4	
skeptical	-I-II	3	
slow-moving	-III+II	1	easy-going
	-I-I	2	
analytic	+V+III		
impartial	-I+IV		
logical	+III+IV		
realistic	-II+I		
shrewd	-II+V		
critical	-II+V		
skeptical	-I-II		
slow-moving	-I-I		
Function:	+I,4 × -I, 4 × -II, 2 × +III, 2 × +IV, 3 × +V		

Table 4.3: monitor/evaluator

Adjective	Loading	Source	Note
creative	+V+V	1	
	+V+V	3	
imaginative	+V+V	1	
	+V+V	3	
innovative	+V+IV	3	
	+V+V	4	
knowledgeable	+V+III	3	
	+V+V	4	
original	+V+I	3	+I is contrary to Belbin's description
forgetful	-III-IV	3	
	-III-III	4	
	+I-IV	2	
unorthodox	+V-III	1	
up in the clouds	+V+V	3	? complex, philosophical
	+V+I	2	
creative	+V+V		
forgetful	-III-IV		
imaginative	+V+V		
innovative	+V+V		
knowledgeable	+V+V		
original	+V+I		
unorthodox	+V-III		
up in the clouds	+V+I		
Function:	+I,-I, 2×-III, -IV, 11 × +V		

Table 4.4: plant

Adjective	Loading	Source	Note
accurate	+III+III	2	
conscientious	+III+II	1	
	+III+II	3	
	+II+III*	4	
good at following through	+III+IV	1	
	+III+IV	3	persevering, self-disciplined
	+III+III	2	
perfectionist	+III+V	1	
	+III+V	3	perfectionistic
	+III+III*	4	perfectionistic
persistent	+I+III	3	
frightened of failure	+I+III	1	competitive
	-IV-I	3	insecure, nervous, fearful
	-IV-I	2	
fussy	+III+III	1	
reluctant to delegate	-II-III	1	distrustful
	-II-IV	3	distrustful
	-III-IV	2	

accurate	+III+III
conscientious	+III+II
firghtened of failure	-IV-I
good at following through	+III+III
perfectionist	+III+V
reluctant to delegate	-III-IV
persistent	+IIII
fussy	+III+III

Function:	+I, -I, +II, 9 × +III, -III, 2 × -IV, +V

Table 4.5: completer/finisher

Adjective	Loading	Source	Note
disciplined	+III+IV	1	self-disciplined
	+III+IV	3	self-disciplined
	+III+III	4	self-disciplined
effective	+III+III	1	efficient
	+III+I	2	
loyal	+II+III	3	
	+II+II	4	
practical	+III+IV	1	
	+III+III	3	
	+III+III	4	
well organised	+III+V	1	
	+III+III	3	Organized
	+III+III	4	Organized
inflexible	-II-IV	1	inflexible or stubborn
resistant tochange	-II-IV	1	inflexible or stubborn
	-V-V	2	
unadventurous	-I-V	1	
	-I-V	3	
	-I-I	4	

disciplined	+III+IV
effective	+III+I
loyal	+II+III
practical	+III+III
resistant to change	-V-V
well organized	+III+III
inflexible	-II-IV
unadventurous	-I-V

Function:	-I, +I,+II,-II,7 $\times$ +III, +IV, -IV, 3 $\times$ -V

Table 4.6: implementor

Adjective	Loading	Source	Note
challengeing	+I+I	3	aggressive, daring
	+I+I	2	
competitive	+I+III	3	
	+I+I	4	
hard-driving	+IV+I	3	indefatigable, weariless
	+I+III	2	
outspoken	-II+I	1	
	+I+I	3	
	+I+I	4	
tough	-II+I	1	proud, outspoken
	+I-II	3	domineering, bossy, forceful
	+I-II	1	dominant
	-II-II	4	
aggressive	+I+I	3	
	+I-II	4	
impatient	-II-IV	1	
	-IV-II	1	
	-IV-II	3	
	-IV-IV	4	
provocative	+I+I	? challengeing, aggressive, daring	
	-II+I	2	

challengeing	+I+I
competitive	+I+I
hard-driving	+I+III
outspoken	+I+I
provocative	-II+I
tough	-II-II
agressive	+I-II
impatient	-IV-II

Function: 9 × +I, 5 × -II, +III, -IV

Table 4.7: shaper

Adjective	Loading	Source	Note
enterprising	+I+III	1	
inquisitive	+V+I	3	
	+V+V	4	
opportunistic	+I+V	3	
	+I+I	4	
outgoing	+I+IV	1	
persuasive	+I+IV	?	
	+I+I	2	
easily bored	+V+I	?	
	+I	2	
erratic	-III-IV	3	*uforutsigbar*
	-III-III	4	
impulsive	-III-IV	3	
	-III-III	4	

easily bored	+I
enterprising	+I+III
inquisitive	+V+I
opportunistic	+I+V
persuasive	+I+I
outgoing	+I+IV
erratic	-III-III
impulsive	-III-III

Function: $7 \times$ +I, +III, $4 \times$ -III, +IV, $2 \times$ +V

Table 4.8: resource investigator

Adjective	Loading	Source	Note
clever	+III+V	1	
	+V+V	4	
professionally dedicated	-II-V	1	narrow-minded
	-II-V	3	narrow-minded
	+III+III	2	
self-reliant	+IV+III	1	
single-minded	-II-V	1	narrow-minded
	-II-V	3	narrow-minded
	-V+III		
technically skillful	???		???
	+III+III	2	
insular	-II-V	1	narrow-minded
	-II-V	3	narrow-minded
	-V-V	2	
not interested in others	-I-I	1	retiring, reclusive, unsociable, or solitary
	-I-I	3	withdrawn, introverted
	-II-II	2	
territorial	-II-IV	1	selfish, distrustful
	+III+I	2	

not interested in others	-II-II
insular	-V-V
professionally dedicated	+III+III
single-minded	-V+III
technically skillful	+III+III
clever	+III+V
territorial	+III+I
self-reliant	+IV+III

Function: +I, 2 × -II, 8 × +III, +IV, -IV, V, 2 × -V

Table 4.9: specialist

Chapter 5

Belbin

R. Meredith Belbin (Belbin, 1981; Belbin, 1993b) outlines a number of types which he call *Team Roles* and which he reports to have discovered during twenty years of research on management teams. The roles are not described in any readily operationable terms in the literature he has provided, indeed, the only operationalizations available are his personality tests and the expert system Interplace (Belbin, 1993b).

The names and descriptions of his Team Roles vary slightly from book to book. Here, the descriptions used in (Belbin, 1993b) will be used unless otherwise noted.

(Belbin, 1993b), then, provides lengthy elaborations and brief descriptions of the Team Roles. One such description (Belbin, 1993b, p. 51) is as follows:

Team Role		*Weaknesses*	
		Allowable	*Not allowable*
Plant	Creative, imaginative, unorthodox. Solves difficult problems.	Preoccupation with ideas and neglect of practical matters	Strong 'ownership' of idea when co-operation with others would have yielded better results
Resource Investigator	Extrovert, enthusiastic, communicative. Explores opportunities. Develops contacts.	Loss of enthusiasm once initial excitement has passed	Letting clients down by neglecting to follow-up arrangements
Co-ordinator	Mature, confident. A good chairperson. Clarifies goals, promotes decision-making, delegates well.	An inclination to be lazy if someone else can be found to do the work	Taking credit for the effort of a team
Shaper	Challenging, dynamic, thrives on pressure. Has the drive and courage to overcome obstacles.	A proneness to frustration and irritation	Inability to recover from situation with good humor or apology
Monitor/Evaluator	Sober, strategic and discerning. Sees all options. Judges accurately.	Sceptisism without logic	Cynicism without logic
Team Worker	Co-operative, mild, perceptive and diplomatic. Listens, builds, averts friction. Calms the water.	Indecision on crucial issues	Avoiding situations that may entail pressure
Implementor	Disciplined, reliable, conservative and efficient. Turns ideas into practical actions.	Adherence to the orthodox and unproven	Obstructing a change
Completer	Painstaking, conscientious, anxious. Searches out errors and ommisions. Delivers on time.	Perfectionism	Obsessional behaviour
Specialist	Single-minded, self-staring, dedicated. Provides knowledge and skill in rare supply	Aquiring knowledge for its own sake	Ignoring areas outside own are of competence

Chapter 6

Construct validity

Do Belbin's Team Roles actually exist?

Belbin's Team Roles are presented in two books (Belbin, 1993b; Belbin, 1981) and in the manual of the Interplace computer program. Even as it is a much used (by SHL in England, Norway, and other countries) instrument for personality assessment and team building, there exist no publically available records or scientific reports to actually demonstrate its validity: in an assessment of an early operatinalization of Belbin's Team Roles, the Belbin Team-Role Self-Perception Inventory (BTRSPI), Furnham *et al.* (1993) go as far as to state that 'the measure is neither theoretically nor empirically derived.' In a reply Belbin (1993a) counters that the BTRSPI is a historical antecedent of INTERPLACE, a system which is supposedly far more robust than the BTRSPI. However, no publicly available examiniation of the psychometric properties of that instrument exists, either.

A handful of authors have tried to validate Belbin's Team Roles, typically either by empirically examining its relation to the 16PF (Furnham *et al.*, 1993; Fischer and Sharp, 1996), or the NEO-PI (Broucek and Randell, 1996). Fischer and Sharp (1996) mentions an additional paper.

These attempts at validation are all entirely empirical. They all give the impression that the validity of Belbin's Team Roles, as operationalized by himself and others, is not particularlt impressive. Even as Belbin states that personality is only *one* of the underlying factors of his Team Roles, one would expect personality to explain a substantial amount of an individual's Team Role.

> If Team Roles are to be held up to scrutiny, there are certain constancies about Team Role behaviours that do require some explanation, even if the way they develop in individual cases is immensely complex. We now know that, while personality differences may underlie Team Roles, other factors, includeing personal values and learned behaviour, also contribute in a significant way to their emergence. (Belbin, 1993a, p. 60)

Fischer and Sharp (1996), as one of the most recent attempts, also finds poor correlations and test-retest validity, and asks:

> The failure to find the expected relationships between the Team Roles derived from the BTRSPI and the 16PF data raises the question in regard to what constructs are being assessed by each of the instruments. (Fischer and Sharp, 1996, p. 66)

This is the problem which will be examined in this thesis.

A validation of Belbin's Team Roles

The previous attempts at validating Belbin's Team Roles have all been empirical. Belbin's operationalization, i.e. his tests, have been pitted against other tests whose psychometric validity is well established.
However, Loevinger (1957) suggests that the examination of the validity of a personality test should begin by examining construct validity. Figure 6.1 shows a graphic illustration of her position.

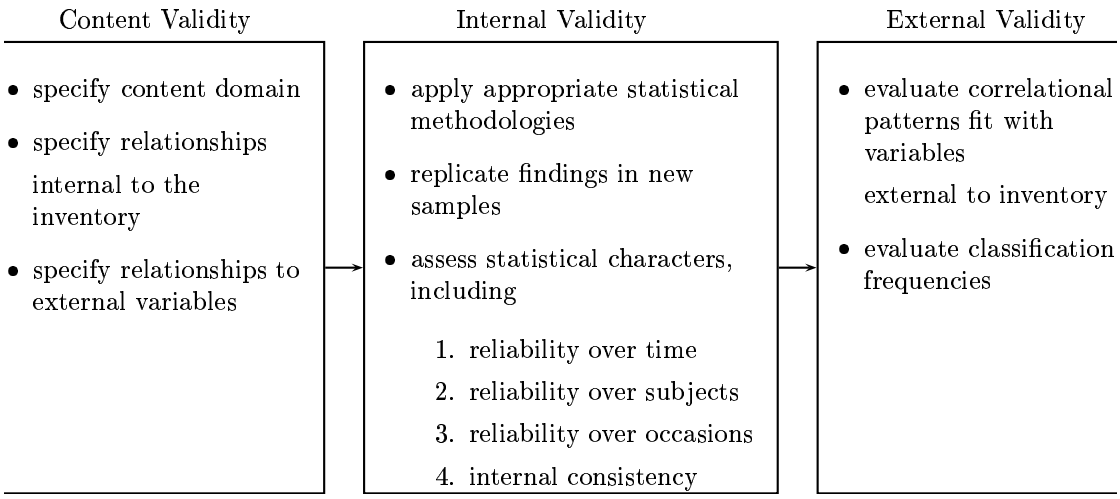


Figure 6.1: Loevinger's process-model of construct validity (adapted from Skinner, 1986)

> [...], since predictive, concurrent, and content validities are all essentially *ad hoc*, construct validity is the whole of validity from a scientific point of view. (Loevinger, 1957, p. 638)

From this position it can be argued that the validations of Belbin's Team Roles which have been attempted show that there is *something* about Belbin that does not have satisfactory psychometric properties, but just what this something actually *is* is not known, and would have remaind essentially unknown *had* adequate psychometric properties been found.
Belbin's Team Roles lack an expressed, publicly available construct validation, and in particular an adequate theory formulation. The

present thesis will consentrate on constructing an adequate theory formulation of Belbin's Team Roles, expressed in terms of the Big 5, and answering to the criteria formulated by Skinner (1986).
The goals of the present reformulation of Belbin's Team Roles in terms of the factors of the Big 5 are:

1. To show that it is possible to build a role or type theory with a basis in the Big 5
2. To pinpoint inconsistencies and contradicions in Belbin's operationalization
3. To tidy up Belbin's theory and reformulate it in a way that is psychometrically acceptable
4. To provide a framework or guidelines for constructing personality tests of Belbin's Team Roles based on any questionnaire that measures the Big 5.

The approach taken in the present thesis will be to examine and improve the content validity of Belbin's Team Roles, the first of the three parts of (Loevinger, 1957) model.

Theory Formulation

The content domain will be the Big 5; more precisely, the AB5C version of the Big 5.
The classification model will be a set of equations which take 5PF-scores as arguments and as a result give an outline of the individual's fitness for Belbin's Team Roles.
The relationships to external variables will be subject to discussion.

Chapter 7

A Mapping From the Big 5 to Belbin's Team Roles

Degree of Closeness

One straightforward way to perform the mapping would be to examine the most significant descriptions of each trait, and from there proceed to establish Team Roles from this fashion. For example, a Shaper is extravert and has high openness to experience, so anybody who scores higher than the median on those two factors might be called shapers, anybody who scored lower than median on those two factors would not. However, this is unsatisfactory: I would like to know *how close* to the role shaper (or any other role) any given individual is, from not at all to very much so.

This will result in a mapping consisting of a set of nine formulae. Each formula takes as its input an individual's score on a questionnaire which measures the Big 5. The output will be nine numbers, giving a profile of the individual as regards his suitability for each of the roles.

There is a need, then, to allow for adjustment not only of an algoritm based on two defining factors, but for the possibility of including other factors than if need be.

A formula which fullfils these criteria would be of the form

$$f_n(x_1, x_2, \ldots, x_5) = w_1x_1 + w_2x_2 + \cdots + w_5x_5$$

where $n \in 1, 2, \ldots, 9$ (one function for each of Belbin's 8 team roles), $x_1, x_2, \ldots, x_5$ represents one score on each of the five factors, and $w_1, w_2, \ldots, w_5$ represents the weights of each factor relative to the Team Role in question. This would result in a list of scores. Translated to T-scores, a score of about 50 would indicate an average example of the role, while much more than 50 would indicate a good example and much less than 50 a poor example.

One might argue that it is questinable how far one can go in assuming linear mathematical relationships to Team Role fitness, e.g. in particuar whether progressively lower scores on factor IV signifies progressively better suitability for Completer/Finisher. The Big 5 assumes a normal population, however: an extremely low score on factor IV still puts one within the accepted range for normal functioning.

Two sets of formulae will be constructed. The first set will be based on a strict interpretation of Belbin's Team Roles as they are operationalized in his INTERPLACE Team Role assessment sheet. This set of formulae will be called the *INTERPLACE interpretation*.

The second set will be based on the first, but with certain modifications: by eliminating all but the most prominent factors from each formula, only the main characteristic of each Team Role will remain. Thus redundancy will be minimized while hopefully sufficient inforfmation will remain. This set of formulae will be called the *Big 5 interpretation*.

Not taking the remaining three (or four) dimensions into account at all seems a dangerous path. Some roles plainly are more complex than others, so there should be ample room for other factors to be taken into account. For instance, one would assume the Plant to be distingushable not only by a distinct personality. It seems reasonable to believe that cognitive intelligence is part of the personal

makeup of the Plant. Similarly, some Team Roles seem to be captured by a wider range of adjectives than others. Presently, tho, the aim is to reduce and simplify.

The formulae will function as hypotheses of suitability for each of the eight Team Role. Thus, an individual's score on the Big 5 will be given as input to eight formulae, giving a preference score for eight Team Roles.

Method

Two sets of formulae were obtained. The first set was based on a *strict* interpretation of Belbin's Team Roles, as operationalized by Interplace's assessment sheet. Each adjective assumed to describe each Team Role was looked up and its five-factor loading tabulated. The resulting tables appear on pp. 32–36. This resulted in the set of formulae displayed in table 7.1 on the next page.

The second set was obtained by interpreting the first result and keeping only the most important factors, and making sure that the resulting formulae were as indepentent as possible. This resulted in the set of formulae displayed in table 7.1 on the following page.

Usage of the formulae were simulated on a random sample of 10 000 individuals. The simulation was performed on a 133 MHz Pentium Compaq Prolinea running Windows NT 4.0. The simulation was written in Visual Basic for Applications under Excel 97, using Excel 97's built-in random number generator. Prototyping was performed using the University of Montreal's Gambit Scheme compiler for the Macintosh and Matlab for Windows.

The input to the functions during the simulations was 10 000 quintuplets of T-distributed random numbers. The random numbers were generated using the following conversion formula from uniformly distributed random numbers to T-distributed random numbers:

$$\begin{aligned} \mathrm{T} &= \mu + \rho \times \sqrt{-2 \times \log \theta_1} \times \cos\left(2 \times \pi \times \theta_2\right) \qquad (7.1) \\ \mu &= \text{mean} = 50 \\ \rho &= \text{stddv.} = 10 \\ \theta_1, \theta_2 &= \text{Random numbers uniformly distributed between 0 and 1} \end{aligned}$$

The functions were linearly transformed so as to obtain T-distributions. The formula used in the transformation was the following:

Given a formula of the form

$$y = f(x_1, x_2, \ldots, x_k) = w_1 x_1 + w_2 x_2 + \cdots + w_k x_k$$

the formula for a normal transformation is:

$$y_{\mathrm{T}} = (y - \overline{y})/\rho_y * s + m$$

where s and m are the desired new mean and standard deviation.

The mean and standard deviation of the untransformed formulae can be rather accurately calculated. The mean of a linear formula with non-correlated normally distrinuted input values is

$$\overline{y} = w_1 \overline{x}_1 + w_2 \overline{x}_2 + \cdots + w_k \overline{x}_k$$

and the standard deviation is

$$\rho_y = \sqrt{w_1^2 \rho_{x_1}^2 + w_2^2 \rho_{x_2}^2 + \cdots + w_k^2 \rho_{x_k}^2}$$

For the present formulae $k = 5$.

		I	II	III	IV	V
f_{tw}	=	$-2x_1 +$	$5x_2 +$	$0x_3 +$	$-1x_4 +$	$2x_5$
f_{co}	=	$3x_1 +$	$3x_2 +$	$2x_3 +$	$4x_4 +$	$2x_5$
f_{me}	=	$-3x_1 +$	$-4x_2 +$	$2x_3 +$	$2x_4 +$	$3x_5$
f_{pl}	=	$0x_1 +$	$0x_2 +$	$-2x_3 +$	$-1x_4 +$	$11x_5$
f_{cf}	=	$0x_1 +$	$1x_2 +$	$8x_3 +$	$-2x_4 +$	$1x_5$
f_{im}	=	$0x_1 +$	$0x_2 +$	$7x_3 +$	$0x_4 +$	$-3x_5$
f_{sh}	=	$9x_1 +$	$-5x_2 +$	$1x_3 +$	$-1x_4 +$	$0x_5$
f_{ri}	=	$8x_1 +$	$0x_2 +$	$-3x_3 +$	$1x_4 +$	$2x_5$
f_{sp}	=	$1x_1 +$	$-2x_2 +$	$8x_3 +$	$0x_4 +$	$1x_5$

Table 7.1: Formulae from Big 5 to Team Roles, INTERPLACE interpretation

Results

A strict interpretation of Belbin's Team Roles

The formulae thus arrived at are displayed in table 7.1.

The distribution of Team Roles in this population (only the highest score considered) were as shown in figure 7.1.

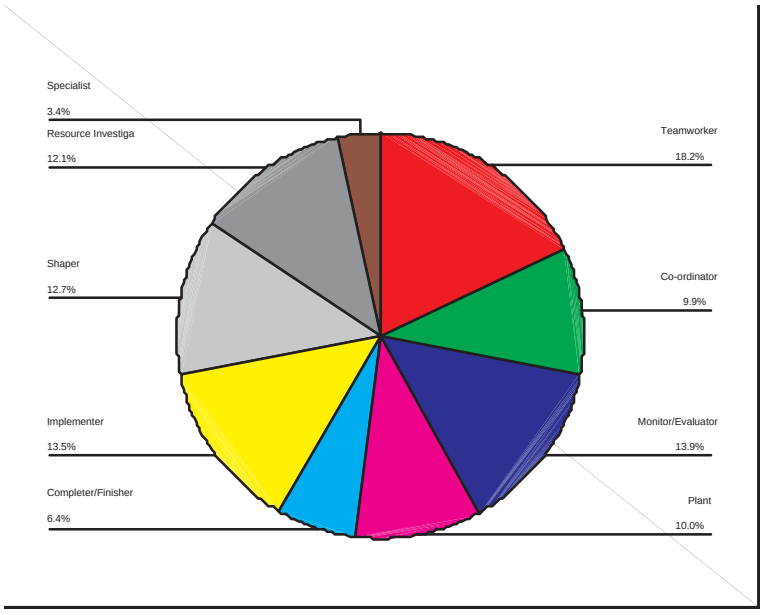


Figure 7.1: Distribution of Big 5 to Team Roles, INTERPLACE interpretation

The correlation between the formulae are shown on table 7.2 on the next page.

A set of Team Roles based on the Big 5 but inspired by Belbin

By selecting the most outstanding factors of each Team Role, the following set of formulae is suggested. This is based somewhat on conjecture: it is not suggested that this is the only alternative.

	TW	CO	ME	PL	CF	IM	SH	RI	SP
TW	1,000								
CO	0,09	1,000							
ME	-,440	0,019	1,000						
PL	0,099	0,100	0,694	1,000					
CF	0,064	-,211	0,078	-,285	1,000				
IM	-,035	0,059	-,232	-,713	0,810	1,000			
SH	-,530	0,050	0,197	-,003	0,014	0,023	1,000		
RI	-,083	0,159	-,040	0,230	-,377	-,400	0,780	1,000	
SP	-,198	0,280	0,532	-,040	0,899	0,827	0,311	-,179	1,000

Table 7.2: Correlations between Team Roles, INTERPLACE interpretation

The following suggestion is based on the following assumptions:

- All individuals should be assigned to at least one Team Role
- Each Team Role should be described by no more than two factors

All of the Team Roles were assigned one corresponding primary factor.

The role of Specialist was removed because it seems more similar to a social psychological role than a personality type.

Three of the roles have a primary loading on one factor and load about half as much on a secondary factor. These are Implementer, Shaper and Resource investigator.

Two of the roles have a primary loading on one factor and load about one fourth as much on a secondary factor. These are Plant and Completer/Finisher.

The remaining two roles are very difficult to interpret: Teamworker and Co-ordinator. Both the Teamworker and the Co-ordinator have two candidates for secondary loading.

This was dealt with in the following way:

For the five 'unproblematic' Team Roles, the primary loadings were assigned a weight of 1, and the secondary loadings were assigned a weight of $-1/2$, even tho the secondary loadings were not quite one half for two of them. This was done, guided by the majority, to obtain symmetry.

The primary function of the Teamworker seems to be to calm the waters. The less formal description given in Belbin's literature suggests that this is his *only* function. Assuming that the remaining adjectives are supposed to describe factor II traits, the Teamworker was assigned a weight of 1 on factor II.

This leaves factor IV totally unaccounted for in terms of primary loadings, which was decided to be the sole domain of the Co-ordinator. The Co-ordinator, in the INTERPLACE interpretation, loads on all of the factors, but has the highest loading on factor IV. Based on the notion that the main role of the Co-ordinator is delegation, and that this has its basis in a laid-back, calm & confident nature, it was assumed that the other adjectives were soppsed to reflect this *or* have been taken care of by the other, more clear-cut roles.

This resulted in the following assumptions of relationships with the Big 5:

Team Role	distinguising characteristic	suggested Big 5 loading
Co-ordinator	emotional stability	IV
Teamworker	sociability	II
Plant	Creative intellect and non-conformity	V, -III
Monitor/Evaluator	Intellect and criticism	V, -II
Implementor	Control and a narrow perspective	III, -V
Completer/Finisher	Control and a tendency to worry	III, -IV
Resource investigator	Surgency and lack of discipline	I, -III
Shaper	Energy and manipulation	I, -II

Assigning $1/2$ as weights of the secondary loadings, this suggests the set of functions displyed in table 7.

$$\begin{aligned} f_{\text{co}} &= x_4 \\ f_{\text{tw}} &= x_2 \\ f_{\text{pl}} &= -1/2x_3 + x_4 \\ f_{\text{me}} &= -1/2x_2 + x_5 \\ f_{\text{im}} &= x_3 - 1/2x_5 \\ f_{\text{cf}} &= x_3 - 1/2x_4 \\ f_{\text{sh}} &= x_1 - 1/2x_3 \\ f_{\text{ri}} &= x_1 - 1/2x_2 \end{aligned}$$

Table 7.3: Formulae from FFM to Team Roles, based on the Big 5

A simulation was carried on under the same assumptions as above. The following distribution of preferred Team Roles is shown on figure 7.2 on the next page:

The correlations between the Team Roles is displayed on table 7.4.

	TW	CO	ME	PL	CF	IM	SH	RI
TW	1,000							
CO	0,010	1,000						
ME	-,459	-,002	1,000					
PL	-,012	0,000	0,799	1,000				
CF	-,001	-,442	0,005	-,398	1,000			
IM	0,009	0,003	-,396	-,798	0,801	1,000		
SH	-,449	-,004	0,209	0,008	0,001	-,005	1,000	
RI	-,002	-,001	0,001	0,201	-,400	-,401	0,800	1,000

Table 7.4: Correlations

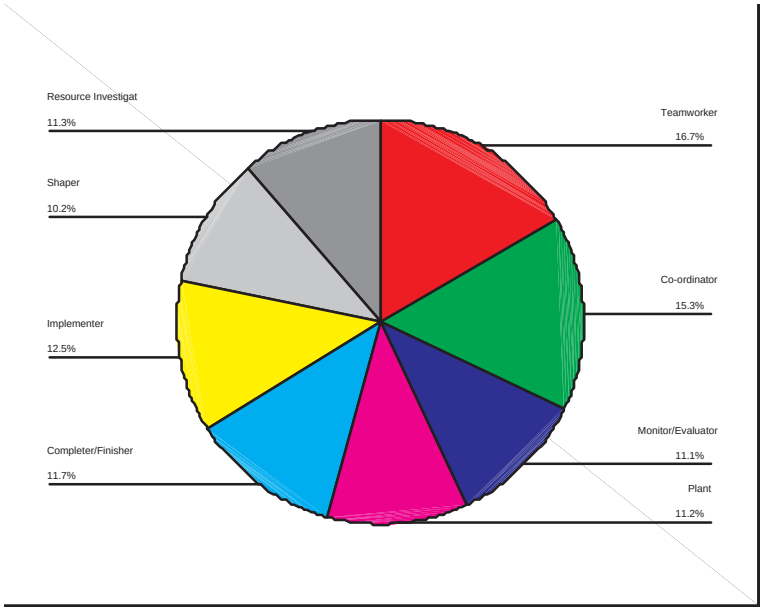


Figure 7.2: Distribution of FFM to Team Roles, based on the Big 5

Chapter 8

Discussion

This has been an attempt to

- theoretically validate Belbin's Team Roles based on the AB5C interpretation of the Big 5
- construct a set of Team Roles based on the Big 5 and inspired by Belbin's publications

Effects on convergent and discriminant validity

One of the present goals has been to increase convergent and discriminant validity. The resulting correlation matrices of the two simulations suggest that this goal has been achieved.
It is impossible to obtain *no* positive correlation between Team Roles. Due to the linear formulas being used, escaping problems with discriminant validity altogether is impossible. However, it is possible to improve it, as has been done here.
16 of 28 pairs of Team Roles have reduced correlations, 13 pairs by more than a factor of 2. 10 pairs have increased their correlations.

Team Roles which share their main factor

The correlation between the three sets of pairs of Team Roles which share their main factor remains high. In fact, the discriminant validity *decreases* in two of the cases, which is to be expected because the formulae are less diluted (have more in common) in the Big 5 interpretation than in the INTERPLACE interpretation. High correlations, then, are to be expected and the situation is improved.

Team Roles which share their secondary factor

Two pairs of Team Roles have the same secondary factor. The correlation of Shaper and Plant increases but remains very low, $r < .008$. The correlation of Monitor/Evaluator and Resource Investigator is supposed to be low, and is fact reduced by a factor of 35.

Team Roles with nothing in common

15 pairs of Team Roles have nothing in common. Out of these, 11 increase their discriminant validity, four have it reduced. Only one of the losses of discriminant validity are by a factor of less than 0.97: The correlation between Plant and Completer/Finisher goes from $-.29$. $-$ 398, which is a factor of .73 (or ca. 1/1.4).

Miscellaneous

Co-ordinator and Teamworker both have no secondary factor and should have zero correlation. This has not been the case in the simulation. The cause of this (and other correlations which have valuse close to 0) can be due to rounding errors or non-randomness of the random number generator. The correlation goes from .122 to .01, a factor of 12.2.

9 pairs of Team Roles have one primary factor in common with another's secondary factor. Out of these, four correlations increase, and two decrease by a moderate amount (by a factor greater than .89). The overall impression is that there has been a non-trivial improvement of validity.

The semantics of the Big 5 interpretation

The decomposition of the adjectives which define each of Belbin's team roles suggests that all of the Team Roles center around one or two of the Big 5. The present reformulation suggests, indeed, that most of the team roles can be viewed as expressions of one factor flavored by another factor.

The Team Roles as they stand show roles which are quite distinct. 15 of 28 pairs of roles show $r < .1$.

The factors are numbered by their relative 'importance,' that is to say, factor I covers the most frequently used trait descriptors while factor V covers the ones least frequently used. In a workplace situation, however, it seems that the relative importance is different.

The perhaps two most important factors are factor II and factor IV, the two most obviously *social* roles. On can direct energy, orderliness, and openness to both things and people, but being warm and laid-back are clearly traits pointing at an ability to be lucid, traits which should be important factors in team work.

The more interesting pairs of Team Roles are those which correlate more than trivially with other roles. The roles which have their major factor in common (e.g. Shaper and Resource Investigator) correlate at ~ 0.8.

For Monitor/Evaluator and Shaper, $r = 0.21$: these are both disagreeable roles; both have a little of the other in them. This is the only pair of roles with no major factor in common to correlate positively > 0.2.

A Completer/Finisher can be expected to have little interest in delegating and organizing ($r = -0.44$ with Coordinator, mostly due to low factor); and have little interest in exploring ideas or collecting resources ($r = -0.4$ with Plant, $r = -0.4$ with Resource Investigator due to low Factor I and V). This is as one would expect from Belbin: the Coordinator, Plant and Resource Investigator are interested in

cooperation and exploring ideas; the Completer/Finisher is interested in getting the job done.

The Implementor is no explorer of ideas, stressing instead the practical application of things. This is to be expected ($r = -0.4$ with Monitor/Evaluator, $r = -0.8$ with Plant, $r = -0.4$ with Resource Investigator). This role seems in fact to be the direct opposite of Plant.

The Monitor/Evaluator is a critical and sometimes cynical explorer of ideas, while the Shaper pushes people forward. The Teamworker, contrarily, calms the waters. The high negative correlation ($r = -0.46$ with Monitor/Evaluator, $r = -0.45$ with Shaper, respectively), mostly due to opposing factor II) should make this clear.

The Coordinator is a difficult role, as Belbin describes this role as a mixture of all of the Big 5. A role which has a high score on factor IV as its main attribute might become mistaken as a role which can handle anything. As it appears that this role does not correlate with any other role, a given Coordinator indeed might be expected to be able to handle any other role as well.

The least distinct roles, Completer/Finisher and Implementor, are the ones which have most correlations in common. The main difference seems to be that the Implementor is less open to ideas, being intent of getting the job done, the Completer/Finisher is more of a type to worry about which things are *not* done. The present model agrees with this: The Completer/Finisher correlates negatively with the easy-going Co-ordinator, the Implementor correlates negatively with the novelty-seeking Plant.

The semantics of the INTERPLACE interpretation

The present interpretation of Belbin's Team Roles suggests that the main problem with Belbin's approach is that in its formulation, all the roles load on most if not all of the Big 5. The end result of this from a psychometric point of view is that the roles become blurred and hard to keep apart in a meaningful or even useful way, as the high correlations between the roles reveals.

Anybody will get a role, but the low discriminant validity suggests that in many cases the ties will be between Team Roles that have very little in common according to Belbin's description.

Chapter 9

Conclusion

One of the reasons for the reported lack of construct validity of Belbin's Team Roles lies in poor content validity. The present paper outlines a way to improve this considerably.

Further research should be done as external validation of this model. One might just define the Big 5 interpretation to *be* the team roles, but this is unsatisfactory. Empirical validations of these Team Roles to external criteria should reveal which adjustments are necessary in order to obtain a description both psychometrically sound and ecologically valid.

Also, an empirical validation with Belbin's INTERPLACE would probably shed light on the differences with Belbin's operationalization. Belbin uses other than personality measuers in order to capture the team roles, perhaps it can be shown that personality is more important than he currently believes.

It should be clear, tho, that it is possible to create a solid theoretical foundation for a set of Team Roles strongly akin to Belbin's – clearly a significant tribute to a researcher who has seen further than he has himself been able to express.

Appendix A

The Program used for the Simulations

```
Option Explicit


' et snapshot av excel-regnearkene som bruker disse funksjonene og
' ble brukt til simuleringene ligger på
' http://www.uio.no/~roffe/takamoto-chock/{ffm2tr,ffm2trlib}

Const Pi = 3.14159265358979


' ******** DOSIMULATE
' ******** kjører et oppgitt antall kall på  funksjonen SIMULATE
' ******** med slumptall som datagrunnlag

Sub doSimulate()

    ' slå av omregning av regneark og oppdatering av skjerm
    ' reduserer simuleringstid fra 1 1/2 time til ti minutter
    '
    Application.ScreenUpdating = False
    Application.Calculation = xlCalculationManual

    ' ta vare på høyde og bredde på det valgte området
    ' slik at man kan veksle mellom 8 og 9 teamroller
    '
    Dim rolesCount, attribCount As Integer
    rolesCount = Selection.Rows.Count
    attribCount = Selection.Columns.Count

    ' aktiver dette arket slik at alle operasjoner
    ' blir relative til dette
    Sheets("ffm2tr").Activate

    ' slett dataene som er der fra før
    Range("J:J").Clear

    ' til tellere
    Dim f, g, i As Integer
```

```
' inneholder resultat av ei kjøring
' må redimensjoneres slik at den holder akkurat så mange
' roller som trengs
Dim tempsim() As Variant
ReDim tempsim(1 To rolesCount, 1 To 2)

' det er lite trolig at det vil brukes annet
' enn fem faktorer i simuleringene
Dim random(1 To 5) As Double

' rollenavn og rollefunksjoner skal behandles for seg,
' derfor splittes de opp
Dim functions As Range
Dim roles As Range

' antall simuleringer som skal kjøres tastes inn på
' regnearket
'
' bør kanskje lages en dialogboks for dette i steden
Dim trials As Integer
trials = Range("A10")

' ta vare på den høyeste verdien (eller de høyeste dersom
' 1.-plassen er delt
Dim max As String


' roles og functions peker på hver sin bit av det
' merkede området
Set roles = Selection.Range(Cells(1, 1), Cells(rolesCount, 1))
Set functions = Selection.Range(Cells(1, 2), Cells(rolesCount, attribCount))


' begynn på rad 2.  rad 1 brukes til overskrifter.
For f = 2 To trials + 1

    ' fyll random-tabellen med fem simulerte scorer for hver faktor
    For g = 1 To 5
            random(g) = Normal
    Next g

    ' do your stuff
    Call Simulate(random, roles, functions, tempsim, max)

    ' legg inn den eller de teamrollene som fikk høyest score
    ' i denne simuleringen
    Sheets("ffm2tr").Cells(f, 10) = max

    ' legg inn scorene som ble brukt som utgangspunkt (for kontroll)
    For i = 1 To 5
        Cells(f, 20 + i) = random(i)
    Next i

    ' legg inn resultatet av kjøringen (for statistisk analyse)
```

```
        For i = 1 To rolesCount
            Sheets("ffm2tr").Cells(f, 26 + i) = tempsim(i, 2)
        Next i

    Next f

    legg inn hele resultatet av siste kjøring (for kontroll)                    100
    For f = 1 To rolesCount
        Cells(1, 26 + f) = tempsim(f, 1)
    Next f


    ' tillatt normal oppdatering igjen
    Application.Calculation = xlCalculationAutomatic
    Application.ScreenUpdating = True
End Sub
                                                                                110
```

```
' ******** TEAMROLLESPREDNING
' ******** Beregner hvor mange ganger hver teamrolle har fått høyest score
' ******** hver rolle får 1 poeng, dividert med antall roller på 1 plass

Function teamrollespredning(argument As Object)
Dim result As Variant

Dim n_cf, n_co, n_im, n_me, n_pl, n_ri, n_sh, n_tw, n_sp, n_else As Integer
n_tw = 0: n_co = 1: n_me = 2: n_pl = 3: n_cf = 4: n_im = 5: n_sh = 6: n_ri = 7: n_sp = 8
n_else = 9                                                                          120

result = Array()
ReDim result(8)

'2 -> 1
'5 -> 2
'8 -> 3
'11 -> 4

Dim thisWeight As Double                                                            130
Dim query As Integer
Dim thisRole As String
Dim role As Integer
For role = 1 To argument.Rows.Count
    thisRole = argument(role)
    thisWeight = 1 / (1 + Int(Len(thisRole) / 3))
    If InStr(thisRole, "cf") <> 0 Then result(n_cf) = result(n_cf) + thisWeight
    If InStr(thisRole, "co") <> 0 Then result(n_co) = result(n_co) + thisWeight
    If InStr(thisRole, "im") <> 0 Then result(n_im) = result(n_im) + thisWeight
    If InStr(thisRole, "me") <> 0 Then result(n_me) = result(n_me) + thisWeight     140
    If InStr(thisRole, "pl") <> 0 Then result(n_pl) = result(n_pl) + thisWeight
    If InStr(thisRole, "ri") <> 0 Then result(n_ri) = result(n_ri) + thisWeight
    If InStr(thisRole, "sh") <> 0 Then result(n_sh) = result(n_sh) + thisWeight
    If InStr(thisRole, "tw") <> 0 Then result(n_tw) = result(n_tw) + thisWeight
    If InStr(thisRole, "sp") <> 0 Then result(n_sp) = result(n_sp) + thisWeight

Next role

teamrollespredning = result
                                                                                    150
End Function



' ******** NORMAL
' ******** gir et T-fordelt slumptall
'
Function Normal() As Double
    Normal = 50 + (10 * (Sqr(-2 * Log(Rnd)) * Cos(2 * Pi * Rnd)))
End Function
                                                                                    160
```

```
' ******** SIMULATE
' ******** Tar en tabell med T-scorer, en tabell med rollenavn,
' ******** en tabell med tilhørende funksjoner for mapping,
' ******** en tabell som skal fylles med resultatet av kjøringen
' ******** og en streng som skal fylles med den eller de teamrollene
' ******** som fikk høyest score

Sub Simulate(n_random() As Double, roles As Range, functions As Range, Optional D, Optional max)

    ' ønsker å kunne variere antall roller                                    170
    Dim rowCount As Integer
    rowCount = roles.Rows.Count

    ' skal fylles med innholdet av det valgte området
    Dim teamroles$()
    ReDim teamroles$(1 To rowCount)

    ' skal holde delresultater for mellomregninger
    Dim data()
    ReDim data(1 To rowCount, 1 To 2)                                        180

    ' en variabel for hver teamrolle
    Dim n_cf, n_co, n_im, n_me, n_pl, n_ri, n_sh, n_tw, n_else, n_sp, as Integer
    n_cf = 1: n_co = 2: n_im = 3: n_me = 4: n_pl = 5: n_ri = 6: n_sh = 7: n_tw = 8: n_sp = 9
    n_else = 10:

    ' skal fylles med verdier fra det valgte området
    ' slik at de kan behandles av Excel's formler
    Dim a As Range
    Dim b As Range                                                           190

    ' tellervariable
    Dim f, g, h As Integer

    ' skal inneholde den teamrollen som testes nå
    Dim n_teamrole As Integer

    For f = 1 To rowCount      'fyll en rad med teamrollenavn
        teamroles$(f) = roles.Cells(f).Value
                                                                             200
        Select Case teamroles$(f)
            Case Is = "cf"
                n_teamrole = n_cf
            Case Is = "co"
                n_teamrole = n_co
            Case Is = "im"
                n_teamrole = n_im
            Case Is = "me"
                n_teamrole = n_me
            Case Is = "pl"                                                   210
                n_teamrole = n_pl
            Case Is = "ri"
                n_teamrole = n_ri
            Case Is = "sh"
```

```
            n_teamrole = n_sh
        Case Is = "tw"
            n_teamrole = n_tw
        Case Is = "sp"
            n_teamrole = n_sp
    End Select

    Set a = functions.Cells(f, 1)
    Set b = functions.Cells(f, 5)

    ' den ene kolonnen får teamrollenavn
    ' den andre får tilsvarende verdi for denne kjøringen
    data(n_teamrole, 1) = teamroles$(f)
    data(n_teamrole, 2) = Application.SumProduct(n_random, Range(a, b))

    ' bereg snitt og standardavvik for denne funksjonen
    Dim mean, std_dev As Double
    mean = functions.Cells(f, 6)
    std_dev = functions.Cells(f, 7)

    ' normér
    data(n_teamrole, 2) = (data(n_teamrole, 2) - mean) / std_dev * 10 + 50

Next f


Dim maxval As Double
Dim sep As String
maxval = 0
sep = ""

' finn én toppverdi
For f = 1 To rowCount
    For g = 1 To 2
        D(f, g) = data(f, g)
    Next g
    If data(f, 2) > maxval Then maxval = data(f, 2)
Next f

' finn alle verdier som har den verdien, vanligvis bare én
max = ""
For f = 1 To rowCount
    If data(f, 2) = maxval Then
        max = max + sep + data(f, 1)
        sep = "/"
    End If
Next f
End Sub
```

List of Acronyms

MBTI Myers-Briggs Type Indicator

FFM Big 5

AB5C Abridged Big Five Descriptional Circumplex

BTRSPI Belbin Team-Role Self-Perception Inventory

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