Determinants of Cognitive Processes Under Conditions of Uncertainty

Dr. Janet L. Sutton

Dr. Keryl A. Cosenzo

Dr. Linda G. Pierce

Presented at the 9th International Command and Control Research and Technology Symposium

September 2004

Research Focus

- Uncertainty is an inevitable component of any military operation.
- One can try to reduce the unknown and increase predictability by gathering and verifying information, but the unknown cannot be completely eliminated.
- Absolute certainty is not possible and decisions will be made based on incomplete, inaccurate, or contradictory information.

Uncertainty affects decision making in:

1. Situation Assessment
2. Coordination
3. Assigning of Roles, Tasks, and Responsibilities
4. Support

Theoretical Framework

"While we try to reduce these unknowns by gathering information; we must realize that we can not eliminate them. The very nature of war makes absolute certainty impossible; all actions in war will be based on incomplete, inaccurate or even contradictory information." (US Marine Corps, 1997)

Traditionally the uncertainty has been examined at the data or situation level. A new approach is needed to examine the effects of uncertainty on decision making; focus on the individual as well as the situation.

Situational Uncertainty

- What we do not know or understand about a given situation.
- Can be due to missing information, ambiguous or conflicting information and complex information (Lipshitz, 1993).
- There are many levels of uncertainty
  - Can be uncertain about specific data (e.g. where is the enemy?)
  - Can be uncertain about the inferences that are drawn about the data (e.g. what can be inferred about the enemy's state of readiness?)
  - Can be uncertain about projections of the future (e.g. What can be inferred about the enemy's intentions?)

Cognitive Uncertainty

- There are individual differences in the cognitive processes that individuals use to make decisions under conditions of certainty.
- Two factors that determine how an individual will cope with uncertainty and conflicted decision-making are (1) Need for Cognitive Structure (NCS), and (2) Ability to Achieve Cognitive Structure (AACS).
  - Cognitive structuring (NCS and AACS) facilitates certainty by filtering out inconsistent or irrelevant information
  - Levels of NCS and AACS affect how an individual perceives a situation and how much time is spent making the decision
- Personality factors may moderate an individuals' response to uncertainty (Greco & Rogers, 2001).
  - Uncertainty Response Scale

Participants

- 44 Staff Officers at Stabilization Force, Bosnia-Herzegovina
  - MNB North, Tuzla, 22
  - MNB North West, Banja Luka, 11
  - MNB South East, Mostar, 8
  - SFOR HQ, Sarajevo, 3

The sample from individual countries was small. Therefore countries were grouped by language roots and first language preference of participants.

- Culture Group - Determined by language roots and first language preference of participants
  - English (n=28) Canada, New Zealand, and the United States
  - Romance (n=8) Spain, Italy, and France
  - Germanic (n=8) Germany and The Netherlands

Instruments

- **Demographic Questionnaire** – Name, title, SFOR rank, branch of service, work location, time in position, location of previous NATO experience, native language, gender, nationality by birth, country of permanent residence

- **Need for Cognitive Structure Scale** (NCS; Bar-Tal, 1999)
  - Identifies extent of an individual's preference for using cognitive structuring

- **Ability to Achieve Cognitive Structure Scale** (AACS; Bar-Tal, 1994)
  - Identifies extent to which individuals are able to apply information processes that are consistent with their need for cognitive structure

- **Uncertainty Response Scale** (URS; Greco & Rogers, 2001)
  - Identifies three coping responses to uncertainty

- **Zuckerman Kuhlman Personality Questionnaire, Form III** (ZKPQ-III; Zuckerman, Kuhlman, & Joireman, Teta, & Kraft, 1993)
  - Identifies five components of personality

Need for Cognitive Structure (NCS) and Ability to Achieve Cognitive Structure (AACS)

Cognitive Structure

Knowledge Structures
Categorization
Schemas
Scripts

Participants rate the degree to which they disagree or agree with statements using a 5-point scale. Responses are totaled to create an overall score.

- **Higher NCS scores indicate a greater need for cognitive structure.**
- **Higher AACS scores indicate a greater ability to apply information processes that are consistent with an individual's level of NCS.**

Implications of NCS x AACS

NCS

AACS	Low	High
Low	•Low Stress •High Use of Stereotypes •Cognitive Structuring •Effortless Processing •High Certainty	•Very High Stress •Low Use of Stereotypes •Effortful Processing •Low Cognitive Structuring •High Uncertainty
High	•High Stress •Low Use of Stereotypes •Effortful Processing •High Piecemeal •Low Certainty	•Low Stress •High Use of Stereotypes •Effortless Processing •High Cognitive Structuring •High Certainty

Adapted from Bar-Tal, Kishon-Rabin & Tabak, 1997

Uncertainty Response Scale (URS)

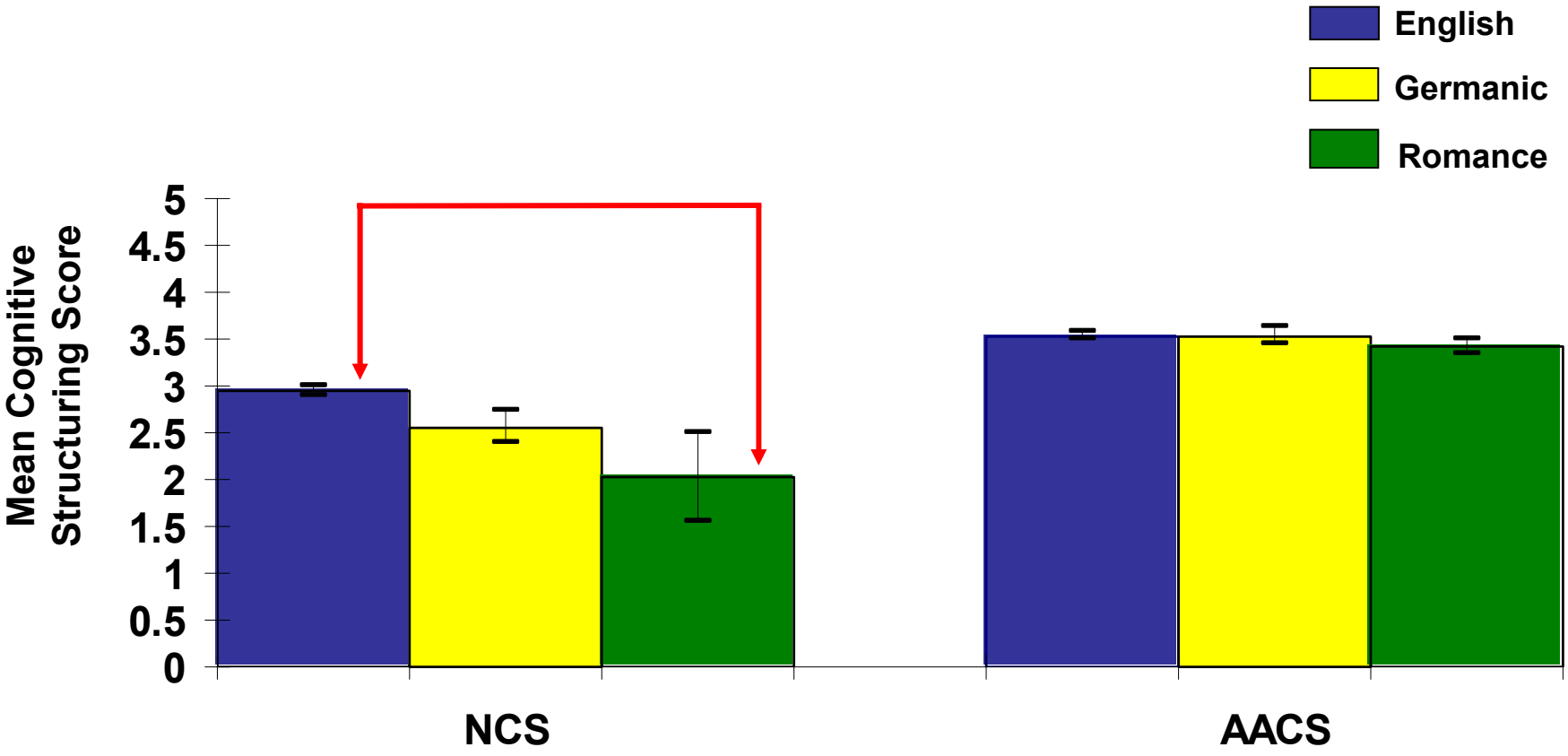
Emotional Uncertainty (EU)	**The degree to which an individual responds to uncertainty maladaptively (i.e. with anxiety and sadness)**
Desire for Change (DC)	**The degree to which an individual enjoys novelty, uncertainty, and change**
Cognitive Uncertainty (CU)	**The degree to which an individual prefers order, planning, and structure in an uncertain environment**

Zuckerman Kuhlman Personality Questionnaire (ZKPQ - III)

Activity – Energy	Measures need for activity, and preference for hard and challenging work
Aggression - Hostility	Measures readiness to express verbal aggression, temper, and tendency to be impatient
Sociability	Measures preference for being with others as opposed to being alone
Neuroticism – Anxiety	Measures degree of tension, worry, obsessive indecision, lack of self-confidence, and sensitivity to criticism
Impulsive Risk Taking	Measures impulsivity and willingness to take risks for the sake of excitement or novelty

Results: Mean Cognitive Structuring Scores

Cultural Group: Wilk's λ (4,72) = 2.57, *p* = .04

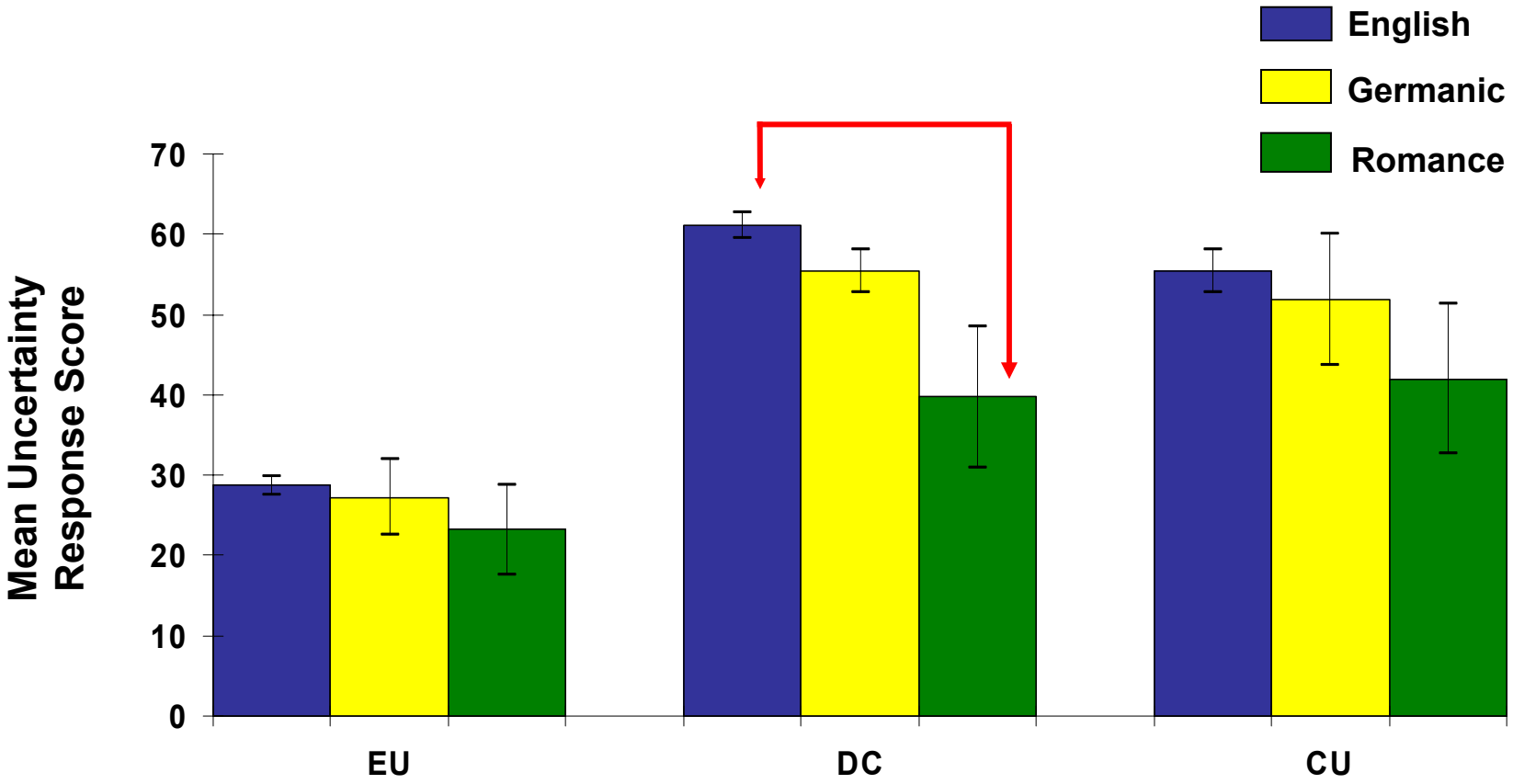


Desire for clear and firm knowledge regarding a topic as opposed to ambiguity.

Extent to which an individual is able to apply information processes that are consistent with the level of need for cognitive structure

Results: Mean Uncertainty Response Scores

Cultural Group: Wilk's λ (6,78) = 2.34, **p = .03**



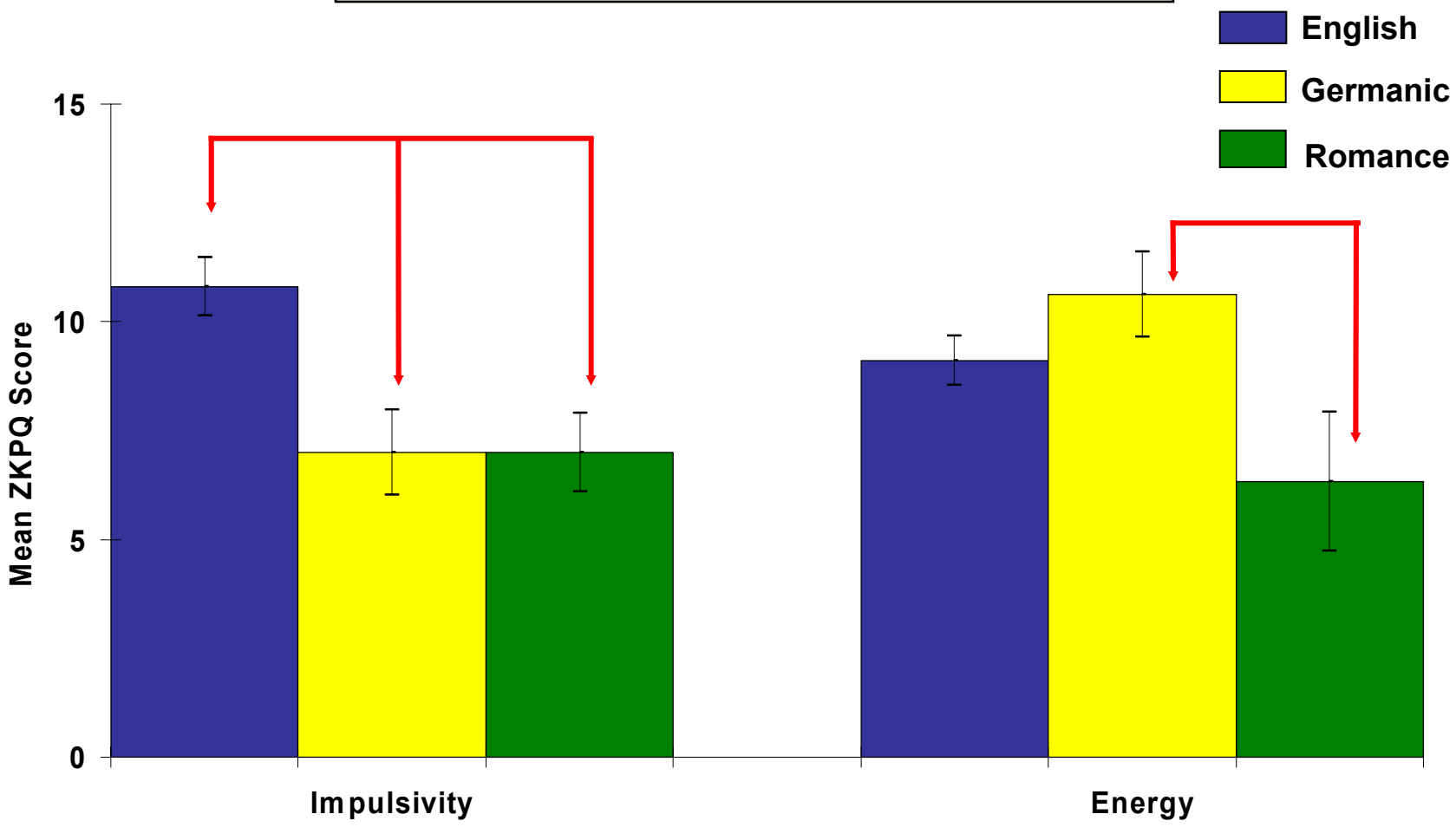
Degree to which an individual responds maladaptively

Degree to which an individual enjoys novelty & change

Degree to which an individual prefers order, planning, & structure.

Results: Mean ZKPQ-III Scores

Cultural Group: Wilk's λ (12,66) = 2.14, *p* = .02



Willingness to take risks for the sake of excitement or novelty

Need for activity, and preference for hard and challenging work

Correlations between Personality and Uncertainty Scales

ENGLISH

- AACS with Sociability (r = .435, *p*<.05)
- EU with Neuroticism (r = .42, *p*<.05)
- DC with Impulsivity (r = .53, *p*<.01)
- CU with Energy (r = .40, *p*<.05)

GERMANIC

- AACS with Neuroticism (r = -.78, *p*<.05)
- EU with Aggressiveness (r = .71, *p*<.05)

ROMANCE

- EU with NCS (r = .75, *p*<.05)
- NCS with Neuroticism (r = -.94, *p*<.01)

Conclusions

- There were cultural differences in the preference for using cognitive structures (e.g. schemas) to make decision under conditions of uncertainty.
  - For example, the English group reported a higher need for cognitive structure than the Romance Group.
  - This difference affects how individuals perceive situations and how they make a decision and possibly group decision making ability and cohesiveness.
- Individual differences of experienced stressfulness of uncertainty is significantly related to personality characteristics.
  - For example, the English group reported more impulsivity than either the Germanic or Romance Group. High impulsivity is characterized by the willingness to take risks.
  - Individuals may have maladaptive coping strategies to uncertainty, but these strategies are different depending on the cultural group.
- Culture appears to be a factor in response styles used to cope with uncertainty. These findings are especially important given the complexity of command and control performance in increasingly uncertain environments and the teamwork requirements.
  - Barriers to effective teamwork can be avoided or overcome when steps are taken to understand one's own and others' cognitive biases and to adapt, as necessary, to ensure successful team performance.

Limitations and Future Directions

Limitations:

- **The sample consisted only of staff personnel in a peacekeeping mission; thus participants were fairly homogeneous in terms of military function.**
- **The sample consisted only of Majors and Captains who have had limited C^2 experience compared to Lieutenant Colonels, Colonels, and Generals. Need for Cognitive Structure, for example, might have been different if all military ranks had been represented.**
- **The disproportion in sample size of culture groups remains a limiting factor in field research.**
- **The instruments (NCS scale, AACS scale, and URS) are new in military applications and generally untested by this scientific community.**

Future Research:

- **Controlled experimentation.**
- **Examine how cultural differences and cognitive uncertainty impact on decision making; possibly manipulate aspects of situational uncertainty and obtain objective performance measures.**