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An Overview and Tutorial of the Repertory Grid Technique in Information Systems Research

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Abstract:

Interest in the repertory grid technique has been growing in the IS field. This article seeks to inform the reader on the proper use and application of the technique in IS research. The methodology has unique advantages that make it suitable for many research settings. In this tutorial, we describe the technique, its theoretical underpinnings, and how it may be used by IS researchers. We conclude by detailing many IS research opportunities that exist in respect to the repertory grid technique.

Keywords: repertory grid, repgrid, personal construct theory, cognitive mapping

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I. INTRODUCTION

The Repertory Grid Technique (RGT) is a cognitive mapping approach [Walsh 1995] useful for understanding how individuals and groups derive meaning from the artifacts and individuals in their environment. The RGT is based on Personal Construct Theory (PCT) [Kelly 1955], a constructivist theory that contends that people experience, organize, and describe their environment in terms of cognitive *personal constructs* that can be distilled into bipolar verbal labels—labels such as *helpful-hurtful*, *emotional-analytical*, or *trustworthy-unreliable*. Complementary to PCT, Kelly [1955] introduced the RGT for eliciting these personal construct systems from individuals. The RGT was initially developed for use in a clinical setting to help diagnose psychiatric conditions and more successfully prescribe treatments [McKnight 2000]. Understanding the meanings embedded within a patient's personal construct systems helped clinical patients in their recovery [Bannister 1965].

The RGT has evolved from the original clinical therapeutic methodology for interviewing patients to a set of general guidelines used in a wide variety of application domains, including environmental studies [Dinsdale and Fenton 2006], education [Kreber et al. 2003; Pill 2005], healthcare [MacCormick et al. 2004; Mickan and Rodger 2005], and business [Ginsberg 1989; Stewart et al. 1981]. Although the RGT has been utilized on a limited basis in research published in recognized IS journals, its use remains limited. Recent research indicates a need for increased exploration of the cognitive aspects of IS-related issues [Heninger et al. 2006; Orlikowski and Gash 1994; Tan and Hunter 2002], an exploration that, we believe, can benefit from using the RGT. The primary aims of this paper are (1) to provide a comprehensive tutorial and review of research that utilizes this technique in order to promote enhanced cognitive IS research; (2) to aid researchers who may be new to this technique; and (3) to provide ideas of future research streams that can most benefit from the cognitive mapping in general and the RGT specifically.

To accomplish these objectives, we build on existing descriptions of the RGT in IS research [e.g., Tan and Hunter 2002] and other extensive reviews of the RGT [Bell et al. 2002; Caputi and Reddy 1999; Fransella et al. 2004; Hagans et al. 2000] by exploring the wide spectrum of variations that compose the RGT [Rugg et al., 2000] and by presenting a flexible and modular framework to guide researchers employing the RGT in IS research.

The RGT is one of many cognitive mapping techniques, each of which has its own advantages and disadvantages [Brown 1992; Byrd et al. 1992]. While no single technique is best for all types of cognitive mapping [Rugg et al. 2002; Walsh 1995], understanding the opportunities and challenges of the RGT can help researchers use the RGT in conjunction with other research methods [Liou 1990]. The RGT differs from other cognitive mapping techniques in that it is highly personal, easy to administer, structured, and facilitates qualitative and quantitative analysis. Some of the key challenges in utilizing the RGT are that it focuses on differentiation in personal construct systems; it sometimes creates monotony; it is often cognitively demanding; it requires a lot of time; it is limited to the specified scope; and it describes rather than prescribes. These pros and cons are elaborated in the next section.

Advantages of the RGT

Highly Personal

Researchers using the RGT *discover* how participants construct their world, whereas many other survey instruments seek only to *confirm* what the researcher understands to be the domain of interest. Because the personal constructs in the repgrid (created through the RGT) are often elicited directly from research participants, the technique can reduce researcher bias and is more transparent to interviewees than other techniques [Boyle 2005; Brown 1992; Crudge and Johnson 2004; Hunter 1997; Hunter and Beck 2000]. When eliciting personal constructs, an interviewer may focus the RGT questioning on concrete examples from a participant's own experience, which makes the results more meaningful to participants [Langan-Fox and Tan 1997].

Easy to Administer

The RGT's highly personal nature makes it relatively easy to administer in practice [Hudlicka 1996]. Trained interviewers can use the RGT to gather data in many different contexts. Many software packages exist to facilitate RGT interviewing and analysis, but the RGT can be just as effectively conducted with simply a trained interviewer, an informed participant, and a pencil and paper.

Structured

Data contained in a repgrid are highly structured, and multiple repgrids can be gathered, analyzed, combined, and compared [Xiangmin and Chignell 2001] using Web-based or stand-alone elicitation and analysis tools [Shaw and Gaines 1996; Verlinden and Coenders 2000]. Researchers can create maps or diagrams from this structured analysis in a simple and straightforward manner [Verlinden and Coenders 2000].

Facilitates Qualitative and Quantitative Analysis

The personal and structured nature of the RGT makes it amenable to both qualitative and quantitative analysis [Brown 1992; Hunter and Beck 2000] and allows the researcher to draw on the strengths of each type of analysis. The data gathered in a repgrid are personal and flexible enough to provide a rich view of a single participant's personal construct system relating to a specific topic, and are structured enough to enhance the comparability and, consequently, the validity of analysis [Langan-Fox and Tan 1997]. The data can be used for quick exploratory analysis—because some results can be obtained without detailed analysis [Hudlicka 1996]—or analyzed further using advanced coding or statistical techniques.

Disadvantages of the RGT

Focuses on Differentiation in Personal Construct Systems

Due to the way that constructs are elicited during the RGT interview, traits of the knowledge domain that are important but not differentiated may be overlooked [Hassenzahl and Wessler 2000].

Sometimes Creates Monotony

For some participants, the RGT construct-elicitation process can be monotonous and lead to higher participant drop-out rates than other techniques [Brown 1992]; however, other participants find the process intriguing [Moynihan 1996] or even fun and challenging [Oppenheim et al. 2003]. The level of participant boredom may be dependent on the participant's level of understanding. Davis [1982] found that for experienced participants whose expertise is housed in long-term memory, indirect methods like the RGT may become frustrating and direct questions may be more effective.

Can be Cognitively Demanding

The RGT can be a cognitively taxing methodology for participants because they must simultaneously consider repgrid elements, personal constructs, and their individual ratings. This may be exacerbated by a complex topic domain or one with which participants are inexperienced.

Consumes a Lot of Time

The entire process of the RGT can be time consuming, with some researchers reporting that 90 minutes were required to create a 9 x 9-inch repgrid [Whyte and Bytheway 1996]. Typical RGT interviews last one to two hours, though other interviewing techniques often take longer, as reported earlier. However, depending on the goal of the research, the researcher may reduce the time required for the interview by supplying the elements (objects the participant is assessing) and/or personal constructs. Furthermore, a researcher can combine this technique with other, less time-intensive techniques to reduce the total time requirements.

Limited to the Specified Scope

As personal constructs have a finite range of convenience, the breadth of information elicited in a single repertory grid is narrow by nature. Additionally, personal constructs are dependent upon the scope of the elements used in the construct-elicitation process. Too much similarity in elements may lead to constructs that are of little use. Additionally, if theoretically interesting tangential topics arise during an interview, a researcher can note them and determine if they are appropriate to include in the repgrid being built. A separate repgrid may be required to examine different topics.

Describes not Prescribes

The RGT facilitates exploration of a knowledge domain as it currently is; thus, it is not the most effective tool for generating alternatives or for capturing participants' expectations and future needs [Verlinden and Coenders 2000]. Placing an imaginary "ideal" element is a technique that can reduce this limitation, as discussed later in this paper.

Given these characteristics of the RGT, we argue that the advantages outweigh the disadvantages in many methodological contexts and that the technique may be fruitfully applied to many problems in IS research—especially if a researcher actively counters some of the disadvantages of the technique. The remainder of the paper is organized as follows. Section II begins by discussing PCT—the theoretical foundation of the RGT. Section III explains how a repgrid is created and analyzed. Section IV reviews the use of the RGT in IS research and suggests areas for additional research.

II. THEORETICAL FOUNDATIONS: PERSONAL CONSTRUCT THEORY

The RGT originated in clinical psychology as a tool to elicit the personal constructs that are at the heart of Kelly's PCT. Kelly describes each person as an "incipient scientist" [Kelly 1955, p. 12] who creates a subjective model of the world—a *construct system*—from an objective reality and then tests and modifies that model based on daily experience. This model is made entirely of interrelated yet distinct bipolar constructs (i.e., characteristics) that allow a person to compare and contrast distinct objects.

A personal construct system is a unique hierarchical configuration of constructs that guides a person's behavior [Kelly 1955; Kelly 1963]. Even when the sets of constructs used by two individuals are similar, the way each individual organizes (i.e., creates relationships among) constructs often differs. To the extent that two persons' construct systems are similar, their cognitive models will also be similar.

The departure of the RGT from the realm of clinical psychology and its widespread use in nonclinical applications has loosened the ties between PCT and the RGT. A researcher does not necessarily have to utilize PCT in order for the RGT to be useful, or a researcher can adopt PCT in his or her work without utilizing the RGT. Others combine the RGT and the theoretical lens of PCT. In a recent article, Davis and Hufnagel [2007] chose to use both the RGT and PCT to provide insights about the personal constructs of fingerprint technicians around a technical automation project. A comprehensive discussion of PCT can be found in Kelly's own works [1955; 1963] and in Bannister and Fransella [1986]. Appendix I contains more detailed information on PCT's main postulate and corollaries.

III. CONDUCTING THE REPERTORY GRID TECHNIQUE

Figure 1 shows a sample repgrid, created as an illustration for this paper. The purpose of this grid might be to understand how an individual perceives different email programs. Within the figure, the labels along the bottom of the repgrid identify the elements. In the original RGT methodology created by Kelly, elements were always people; however, over time researchers have examined many different objects as elements. In Figure 1, the elements are email programs. Labels along the sides of the grid comprise the bipolar personal constructs, and the numeric values within the grid represent the individual's ratings of the elements along each individual construct. The RGT provides a technique in which the interviewer and the participant create the repgrid by defining the elements, identifying the constructs, and rating each element on each construct.

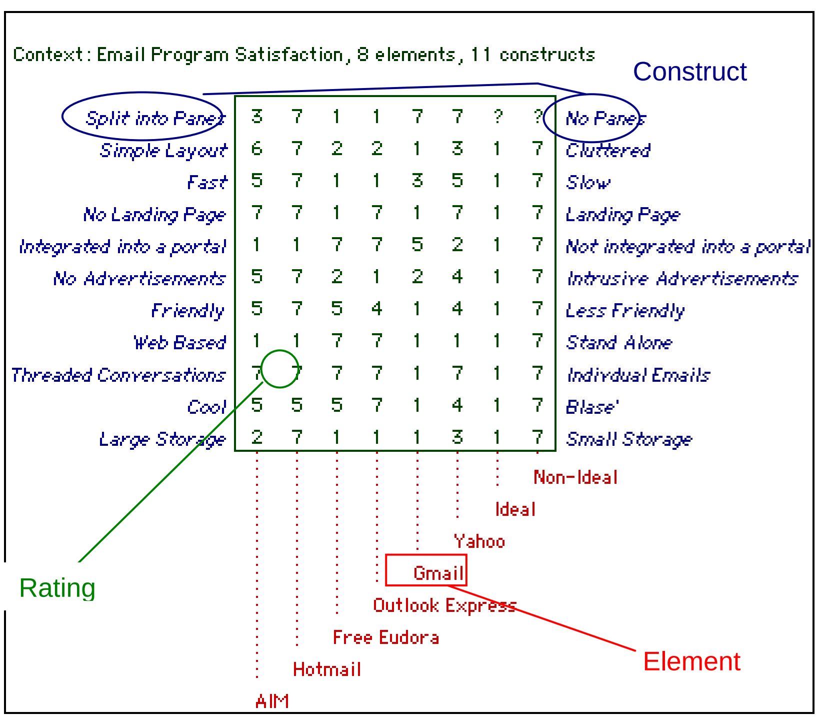

Figure 1. Sample Repertory Grid

The RGT consists of four major stages: pre-interview, interview, review, and analysis. Each stage consists of a combination of activities that a researcher or analyst chooses and configures to suit his or her needs. These processes are illustrated in Figure 2 and are outlined below.

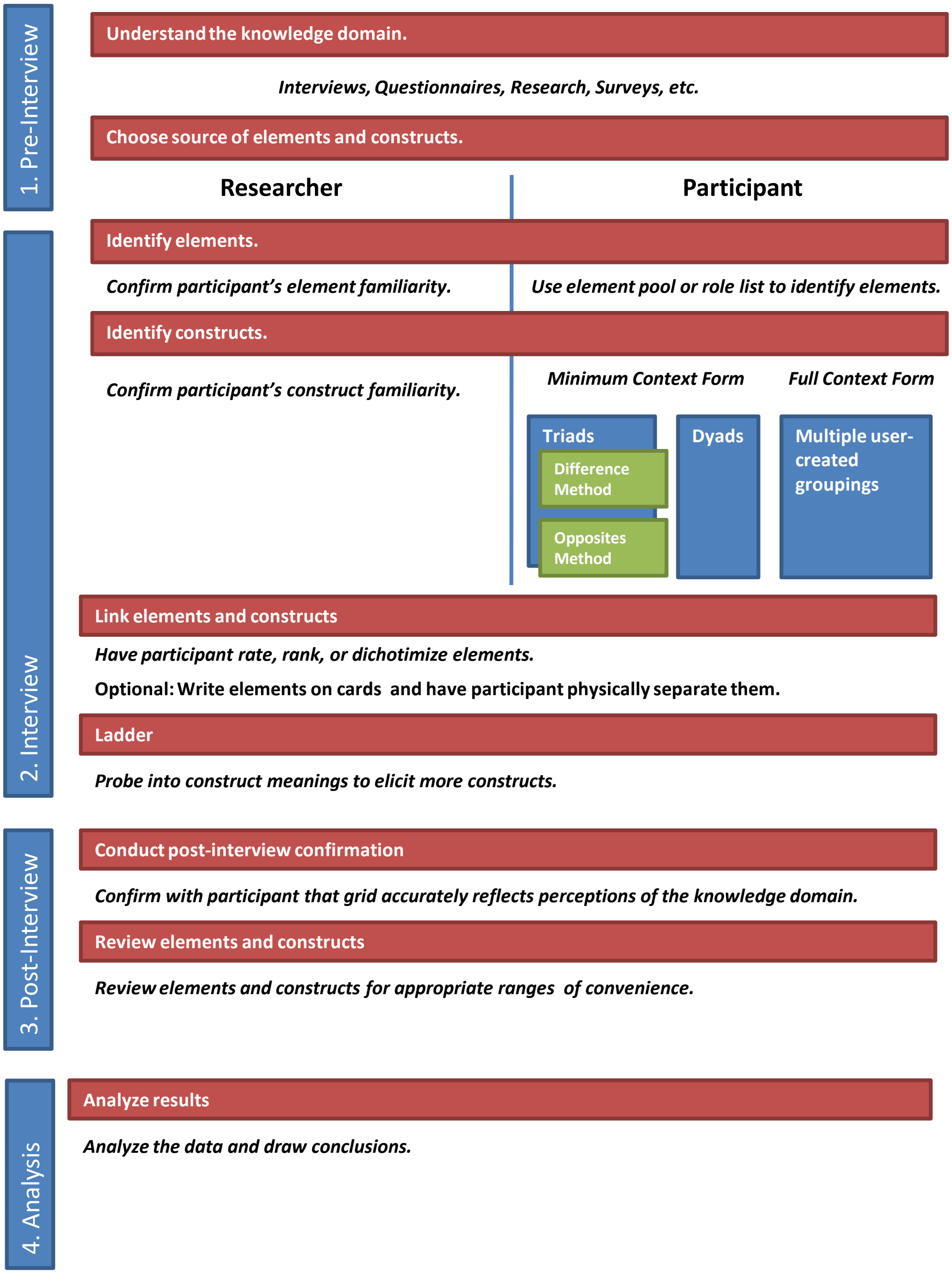

Figure 2. Four Stages in Creating a Repgrid

Stage 1. Pre-Interview

In this stage, the researcher becomes familiar with the knowledge domain so he or she can make informed decisions about interview methods and direct the research participant in completing the repgrid. The two primary activities of this stage are acquiring understanding of the knowledge domain and choosing the source of the elements and constructs.

Acquire an Understanding of the Knowledge Domain

A researcher can become familiar with the knowledge domain by conducting interviews, distributing questionnaires, performing preliminary research, forming focus sessions with groups or individuals [Grudnitski 1984; Langan-Fox and Tan 1997], or reviewing relevant literature.

Choose the Source of Elements and Constructs

Although we treat element and construct elicitation separately, and in further detail later in the paper, the pros and cons regarding the sources of both are similar. In light of the following guidelines, the researcher must choose the source from which he or she will identify elements and constructs.

Identified by the Researcher. Before the interview begins, the researcher can identify repgrid elements and/or constructs [Rentsch 1990]. Doing this reduces interview time and allows researchers to compare grids statistically along common elements or constructs. However, this introduces researcher bias and offers less personal representations of an individual's understanding and preferences [Adams-Webber 1998]. Introducing elements may be less biasing than supplying constructs if subjects are familiar with the elements.

Identified by Each Individual. Elicitation of elements and/or constructs from individuals introduces the least amount of researcher bias into the grid structure. Individual elicitation of constructs and elements is particularly useful in preliminary or exploratory studies where a wide set of diverse attributes is desired [Whyte and Bytheway 1996].

Stage 2. Interview

During this stage, elements and/or constructs are elicited from a participant (unless the researcher supplies them), and the interviewee enters ratings in the repgrid. If the researcher does not provide the elements or constructs, he or she first introduces the domain of interest (email programs in our example) to the participant, who identifies elements with which he or she is familiar. Once the elements are identified, the constructs are elicited. *Triadic elicitation, or triading,* is the most common method to elicit constructs in the RGT. In this method, the researcher presents three random elements to the participant and asks the participant how two of the elements are similar to each other and different from the third. Once a bipolar distinction between the three elements is made (e.g., fast–slow), that distinction becomes a construct on which all other elements are rated. All personal constructs require both the left- and right-hand poles. This process of distinguishing between triads and rating all elements on the elicited construct continues until the participant cannot think of any new constructs. Some software packages require a minimum number of elements or constructs to perform some statistical analyses. A researcher may use a laddering technique during the interview process to help the participant think of new constructs. An analyst performs laddering by asking "how," "why," and "what" questions about an elicited construct that allow the analyst to understand both the broader context and the deeper meaning of an idea [Reynolds and Gutman 1984; Reynolds and Gutman 1988].

With this overview of the interview stage, we will now discuss specific practices during the interview stage such as interviewee familiarization, element identification, construct identification, and linking. Throughout the process, the interviewer can employ a laddering technique to clarify and expound upon participant meanings.

Interviewee Familiarization

If the researcher chooses the elements or constructs during the pre-interview stage, he or she can hold a familiarization session with the participants, as Crudge and Johnson [2004] did in their research on search engine usability. If the participant is not familiar with the elements or constructs, the researcher can change or clarify them, use a subset of elements or constructs, or drop the participant.

Element Identification

If the researcher did not identify elements during the pre-interview process, he or she must elicit elements from the group or from the individual during the interview process. The researcher can elicit elements through an element pool, a role list, or a discussion. An *element pool* identifies a general domain from which the interviewee can identify a group of elements. Such a pool could as simple as directing the participant to "list six email programs with which you are familiar."

A *role list* is a list of short sentences (one for each element) that describe typical elements in the domain. Early role lists used descriptions of people such as "best friend" or "disliked person" to elicit elements. In our example, a role list could include roles such as "an email program you use often," "a Web-based email service," and "an email program you no longer use." The participant then matches each role description to an actual entity, such as Gmail or

Eudora Lite. The role list can be created from scratch by doing preliminary interviews, or it can be put together from modified versions of lists used in previous research [Carlsson 1988]. With a role list, the participant is forced to cover select elements within the domain of interest but is free to choose those elements.

Discussions between the researcher and interviewee can also yield a set of negotiated elements and allow the researcher to direct the element-identification process interactively.

Construct Elicitation

If the researcher did not identify constructs during the pre-interview process, he or she must elicit them from the group or individual during the interview process. The researcher can elicit constructs by using either full-context form or a variation of minimum-context form.

Full-Context Form. Using a full-context form, the participant or group identifies groupings of similar and dissimilar elements from the list of elements and provides the researchers with a verbal label of each of the groupings [Tan and Hunter 2002]. For example, given a set of six cards, each with the name of an email program written on them, a participant might divide them into two piles: *Web-based* and *stand-alone*. These two labels become the poles of one construct. The participant repeats this sorting process until the participant can no longer think of meaningful construct groupings.

Minimum-Context Form. Using a minimum-context form of construct elicitation, participants identify groupings of elements from a random subset of two or three elements rather than from among the entire set of elements. For example, a researcher presents a participant with a random group of three email programs (a triad) and asks him or her to describe how two of the elements are similar (convergent or left-hand pole) and a way that the other is different (divergent or right-hand pole). The researcher repeats this sorting process until the participant can no longer think of meaningful distinctions or similarities among triads.

Research has shown that small variations in the way in which a researcher carries out the minimum-context form can affect the resulting repgrid. In particular, studies suggest that element triads are more desirable than element dyads [Caputi and Reddy 1999; Hagans et al. 2000] and that construct labels distinguished through examination of element differences are more desirable than those distinguished through element opposites.

Dyads vs. Triads. In some research, construct elicitation is performed by prompting the interviewee to identify distinctions between two (instead of three) elements. Although this dyadic elicitation technique is useful in experiments where time is a priority or the participants are small children, the general consensus is that constructs elicited using the dyadic method are not as useful as those elicited using the triadic method [Caputi and Reddy 1999]. Constructs elicited through triads have greater variation, are better able to discriminate among many elements, and generally produce results that are more cognitively complex [Caputi and Reddy 1999], in part because they are elicited through comparison of both similarities and differences. Dyadic elicitation focuses only on differences.

Difference or Opposites. When a researcher presents elements as triads, a participant can identify construct poles by either the difference method or the opposites method. Both methods prompt the participant to identify and verbally label how two of the three elements are similar. Using the *difference* method, the participant would then identify how the third element is *different* from the other two. Using the opposites method the participant is prompted to identify the *opposite* of the label used to describe the first two elements.

Although these two techniques vary just slightly in their elicitation approach, there are at least three differences in the outcomes of constructs elicited using the difference and opposites methods [Hagans et al. 2000].

The first distinction is that the *difference* method creates more bent constructs than the opposites method. *Bent constructs* are constructs that do not contrast two opposites and may not be mutually exclusive (see Figure 3). The problem with bent constructs is that the construct may be describing two ideas embodied in one construct. For example, the construct *happy-sad* is mutually exclusive, opposite, and embodies one construct. The construct *happy-confused*, however, could be a mix of two constructs: *happy-sad* and *clear thinking–confused.* A skilled interviewer may be able to help a participant determine if a participant means a single construct or multiple.

The second difference between the two methods is that the opposites method creates poles that may be too extreme to describe the constructs. In describing attributes of email programs, for example, a participant using the difference method might say that two of the three programs are friendly while the other is less friendly. Using the opposites method, however, the participant might identify two of the programs as friendly, and choose hostile as the construct's other pole. The opposites method creates a construct whose pole (*hostile*) is too extreme to be appropriately applied to any the elements [Neimeyer et al. 2005].

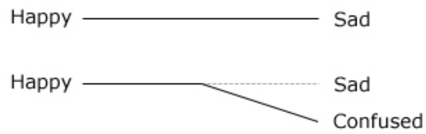

Figure 3. Graphical Representation of a Bent Construct

The third difference between methods is that constructs elicited through the opposites method may not apply to any of the elements. Using the example above, none of the programs can be described as hostile, but some are definitely less friendly than others are. Thus, using the difference method, each pole of the bipolar construct is sure to apply to at least one of the elements in the set [Hagans et al. 2000]. For these reasons, many researchers prefer the difference method to the opposite method and will probe further (using laddering or other questions) to examine bent constructs.

Number of Constructs. Although no specific rules exist on the number of constructs that should be created, most studies range from 10 to 25 [Bannister 1968; Fransella et al. 2004], and most salient constructs can be elicited from just 7 to 10 triads [Reger and Huff 1993].

Linking of Elements and Constructs

After the researcher or participant identifies each construct, or after he or she creates the entire list of constructs, the participant can link elements and constructs by (1) dichotomizing, (2) ranking, or (3) rating. In this process of linking, the researcher can employ laddering to elicit additional constructs and/or to understand the meaning of a person's constructs more fully.

Dichotomizing. Kelly's original repgrid applied a dichotomized (bimodal) evaluation to each element on each construct. On a construct of *simple layout–cluttered*, for example, a person would place a tick or checkmark, indicating that the email program had either a simple design or a cluttered design. If an element needed to be rated in the middle of a bipolar construct, then the element needed a different construct to explain the ambiguity [Beail 1985]. One problem with this approach is that it can force the research participant to make crisp distinctions where they might not actually exist.

Ranking. An alternative to the semantic scale is to rank each of the elements on a continuous scale. Stewart and Stewart [1981] suggest that this method helps the participant decide which elements are similar and which are different according to the specific construct. Hunter and Beck [2000] use cards to help participants rank attributes of systems analysts. Unfortunately, this technique introduces method variance, which may lead to inaccurate analysis. This leaves the rating technique as the preferred method for linking elements and constructs.

Rating. As a solution to the forced distinction problem and to reduce method variance, numerous studies have modified Kelly's repgrid to use a semantic scale to rate elements on each construct. This is widely used and accepted by most repgrid researchers but is not without criticism. Eden and Jones [1984] point out that this approach may be contrary to Kelly's original theory [1955] of dichotomous constructs. Another problem is that a rating in the middle of the scale could be interpreted by the researcher incorrectly as either indifference or uncertainty [Eden and Jones 1984; Yorke 1983]. Despite these critiques, our contention is that rating scales provide the best option of the three when linking elements with constructs.

Laddering. Laddering is a technique that allows the researcher, together with the participant, to explore the rationale for, the meanings of, and the relationships between different constructs. Applied to repgrids, this technique requires the researcher to qualitatively identify and further elicit similar elements/constructs and construct hierarchies. A researcher can use this technique in any stage of the repgrid interview process to elicit more information about the constructs and explore their hierarchical relationships [Rugg et al. 2002]. To perform laddering, the researcher uses a set of standard questions to move sideways, upward, or downward from a seed item, or starting point. The researcher can then use a standard notation set to record the research participant's responses.

Laddering can be especially useful in understanding evaluative but ambiguous constructs such as *friendly–less friendly.* This construct, while evaluative, gives the researcher little actionable insight into how to make an email program more or less appealing.

To probe downward, the researcher might ask, “What characteristics of the program make it more or less friendly?” To which the participant might respond with new constructs like *familiar logo branding–unfamiliar branding*, or current constructs like *intrusive advertisements–no advertisements*. These new constructs help researchers understand a person’s construct system and give insight into hierarchical relationships between constructs.

In a similar fashion, a researcher can use laddering to discover higher-level constructs. For example, if the participant had provided the construct *familiar branding–unfamiliar branding*, then the interviewer could ask, “Why is that distinction important to you?” and the subject may have provided the *friendly–less friendly* construct.

Sideways laddering uncovers items similar to the one in question. Using the construct *split into panes–no panes* as the seed item, the researcher might say, “This construct describes the structural layout of the program. What other pertinent attributes can you think of that describe structural layout?” Young et al. [2005] use laddering to go deeper into interviewee meanings of their communicative and noncommunicative constructs. For a full treatment of the laddering technique, see [Reynolds and Gutman 1984; Reynolds and Gutman 1988].

Stage 3. Post-Interview

In the post-interview stage a researcher or analyst can review the created repgrid with a participant to refine the elements or constructs as needed. This can be done by confirming the grid and/or reviewing the elements and constructs.

Confirm Grid

This optional step allows the researcher and participant to quickly confirm that what was recorded during the repgrid interview represents the true beliefs, feelings, meanings, perceptions, or interpretations of the research participant and that those attributes are accurately understood by the analyst [Hunter 1994]. During this process, the researcher allows the participant to change any ratings that he or she desires.

Review Elements and Constructs

After the elements and/or constructs have been elicited, the participant can review them to ensure that they appropriately cover the desired range of the knowledge. This can be useful in determining missing elements or constructs. If the range of elements is too wide, a researcher can work with the research participant to eliminate elements or can group elements from tangential domains into separate grids [Eden and Jones 1984] and link them [Bradshaw et al. 1987]. If the element scope is too narrow, the researcher can use laddering to explore more elements, use a role list, or create imaginary “ideal” and “non-ideal” elements to spread the range of elements to the extremes [Crudge and Johnson 2004; Hunter and Beck 2000; Stewart et al. 1981; Whyte and Bytheway 1996; Young et al. 2005]. The addition of ideal and non-ideal elements also lets the researcher anchor comparisons between elements and constructs [Hunter 1994].

During and after the post-interview process, participants should be able to change ratings, constructs, or elements until they feel that the repgrid accurately represents their understanding of the knowledge domain.

Stage 4. Analysis

During the analysis phase, the researcher or analyst submits the completed repgrid to either statistical or qualitative analysis. Analysis helps the researcher understand the content and organization of the participant’s construct system. Researchers can analyze the content of the grid (its element and construct labels) or the grid ratings. *Content analysis* can be used to understand textually the construct labels. *Ratings analysis* provides insight on content organization. Researchers often use cluster analysis, principle components analysis (PCA), multidimensional scaling (MDS), logical analysis, and conceptual mapping to analyze ratings. They also occasionally employ various summary measures to capture a single aspect of the grid structure. Various software packages are available for analyzing and creating repgrids. We have listed many of these in APPENDIX II.

Once a researcher and a participant create a repgrid and rate elements on constructs, the researcher has a matrix of labels and numbers that yields two areas of analysis: the construct labels and the element-construct ratings.

First, the element and construct labels themselves are a type of data that can help the researcher draw qualitative interpretations of how the participant views the domain in question. Alone, a researcher can group and analyze these construct labels without regard to the ratings using content analysis or some other type of qualitative coding.

Second, the numerical evaluations of the elements on the constructs give the researcher a deeper look into the meaning of and relationships between constructs and elements. Analysis of element-construct ratings reveals relationships (1) between elements, (2) between constructs, and (3) between elements and constructs jointly [Bell 1990]. Analysis of these element-construct ratings falls into one of four categories:

1. Statistical analysis (cluster analysis, PCA, or MDS)
2. Conceptual mapping
3. Logical analysis—Gaines and Shaw method, uncertainty coefficient, phi coefficient, Proportionate-Reduction-in-Error measure, etc.
4. Summary measures—Landfield's Ordination, Bieri's Cognitive complexity, etc.

Multiple analysis techniques can be combined in the same study [Boyle 2005] to enhance validity of results [Latta and Swigger 1992]. We describe each of these techniques in the following paragraphs. We then discuss their extension to the analysis of group-level data.

Eden and Jones [1984] suggest that the element and construct elicitation phases are perhaps the most valuable stages of the repgrid technique and that rating elements is often too time consuming to be worth the effort. In fact, in his study on personal constructs for systems projects' risk, Moynihan [1996] elicits elements and constructs from his participants but forgoes the linking step altogether. When analyzing elements or constructs, researchers can also use frequency counts to find common trends among individuals [Boyle 2005].

A researcher can analyze elements and constructs without their corresponding ratings using a technique called content analysis. *Content analysis* [Feixas et al. 2002; Hunter 1997; Moynihan 1996] is a subjective qualitative analysis by which elements and/or construct labels are placed into common categories or main issues and interpreted for meaning [Langan-Fox and Tan 1997].

Applied to repgrids, this would involve qualitative identification of groupings of thematically similar elements or constructs. Using our email example as an illustration, a researcher might assign elicited constructs into the following groups: *features*, *overall perceptions*, *layout*, and *other*. He or she could then group elements into *stand-alone*, *Web-based*, and *hybrid* categories. These subjective groupings are useful for the generalization of constructs and elements, for identifying trends between classifications and for creating questionnaires. It is also useful, as we will discuss later, in comparing different grids whose elements and/or constructs are not similar.

Statistical Analysis of Ratings

Many statistical techniques are appropriate for the analysis of repgrid ratings. We will discuss cluster analysis, PCA, MDS, conceptual mapping, logical analysis, and other summary measures in this section.

Cluster/Correlation Analysis. Cluster analysis enables the researcher to analyze relationships between constructs or between elements, but not between elements and constructs together. Cluster analysis of repgrids involves the quantitative identification of groups of similar elements or similar constructs based on highest statistical correlations. An analyst can express these groupings visually on a tree diagram, as in Figure 4.

The tree diagram visually portrays possible relationships between the elements and between the constructs. By glancing at this figure, the researcher will recognize three main groups of closely correlated elements: group one consists of Ideal and Gmail; group two consists of Yahoo, AIM, Hotmail, and Non-Ideal; and group three consists of Outlook Express and Free Eudora. The first six elements also form a cluster of elements that are more similar to each other than they are to Outlook Express and Free Eudora.

These groupings also give the researcher insight into the hierarchical structure of a participant's personal constructs [Shaw and Gaines 1998], in theoretical accordance with Kelly's organization corollary (see Appendix I).

Most of the groupings in Figure 4 make sense on their face. Programs that are *cool* will also be *friendly*, and those that are *fast* will naturally have *less advertisements* and a *simple layout*. However, when seemingly unrelated elements or constructs show high correlations (such as constructs *landing page–no landing page* and *individual emails–threaded conversations*), a researcher may want to explore the reasoning behind anomalies with the research participant.

An exploratory variation on cluster analysis is simple linkage clustering, as described in [Eden and Jones 1984]. This method computes the absolute value of the sum of the numerical differences between pairs of constructs or elements. These values are normalized on a 0-to-100 scale where 0 indicates a complete dissimilarity of constructs or elements and 100 means a complete similarity.

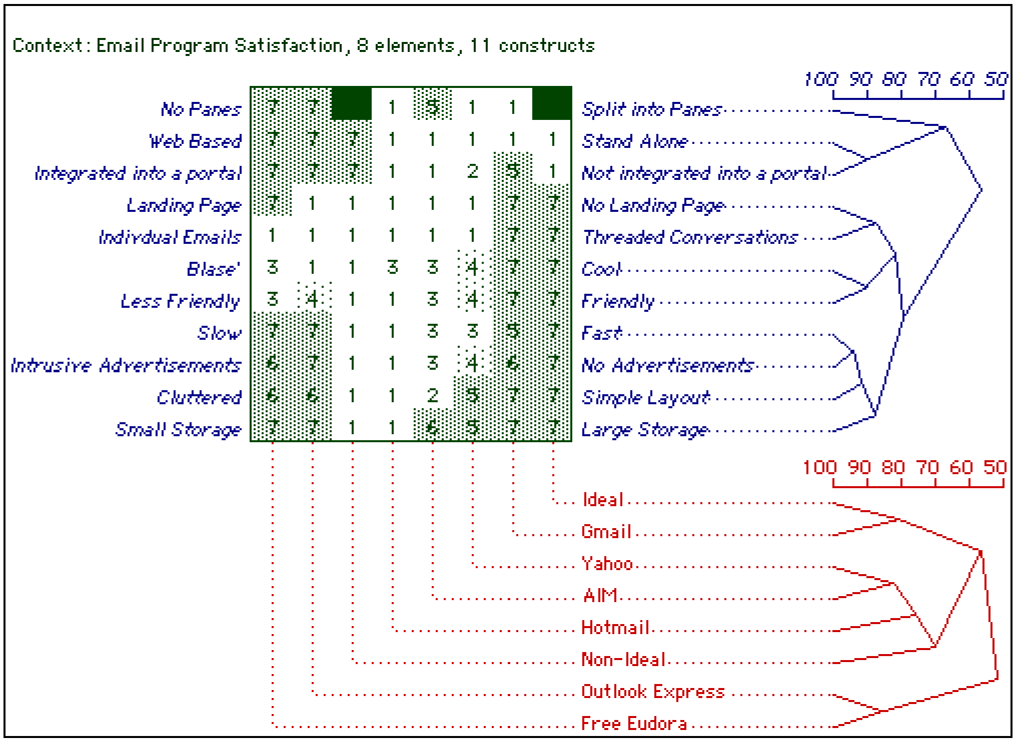

Figure 4. A Tree Diagram from Gaines and Shaw's Rep IV Software, Showing Relationships between Elements and Constructs

For example, the absolute value of the sum of numerical differences between two statistically similar programs like Outlook Express and Free Eudora is 10. The difference between two statistically different programs like Gmail and Hotmail is 47. The lower the number, the more closely the pair of elements is related. This type of cluster analysis is less complicated and more transparent than its statistical variant and can be done easily by hand in grids with less than seven elements.

Another variation on correlation analysis involves measuring how strongly a construct is correlated with an individual's ideal [Whyte and Bytheway 1996]. This analysis requires the researcher to supply an imaginary "ideal" or "successful" element that the participant will use to make ratings.

Cluster analysis is conceptually straightforward and enables the researcher to quickly identify relationships between constructs or between elements. There are, however, drawbacks to cluster analysis [Easterby-Smith et al. 1996]. First, cluster themes are often difficult to label or identify. Second, specific correlation algorithms may differ from one procedure to another. Most cluster analyses of repgrids use the FOCUS algorithm, created by Shaw [1980]. Third, constructs may correlate mathematically, but may not make logical sense. Fourth, the technique cannot show element-construct relationships. Fifth, clusters show correlations but do not show which factors in a cluster might be most important in a decision-making process [Phythian and King 1992].

Principle Components Analysis. The second main type of statistical repgrid analysis is performed using a technique called *principle components analysis* (PCA) [Bell 1990; Easterby-Smith et al. 1996; Leach 1980; Tan and Hunter 2002]. PCA is a data reduction technique used to find dimensions of maximum variability in data. Some analysis packages (e.g., Rep IV) utilize PCA to produce plots that represent relationships among the constructs and elements spatially. Spatial distance between and among elements and constructs suggests how they might be related to each other.

A graphical representation of PCA is shown in Figure 5. Using this method, the researcher can easily notice clusters of common elements and constructs. He or she can also observe that the general cluster of Outlook Express and Free Eudora is spatially closest to those constructs that effectively describe the stand-alone class of email programs—not integrated into a portal, split into panes, and stand alone.

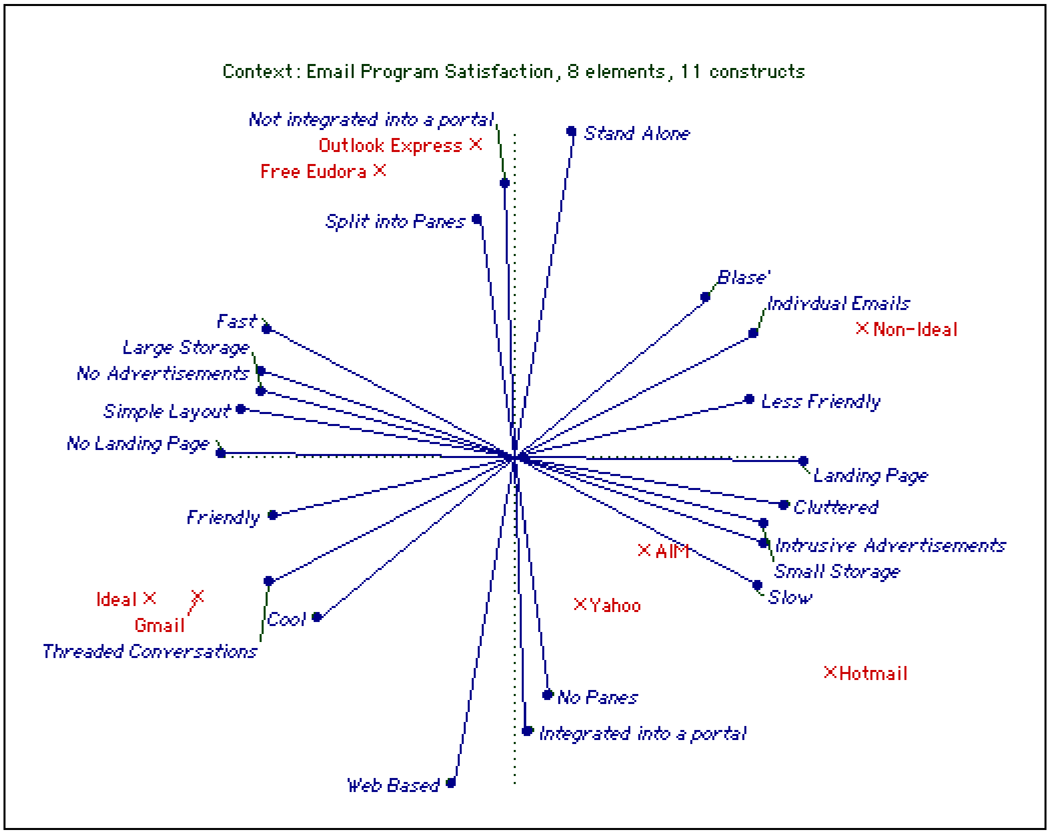

Figure 5. PCA of Email Programs

Multidimensional Scaling (MDS): MDS is an analytical technique designed to create graphical representations of the similarities and differences in the ratings of multiple objects. MDS is an alternative for mapping the distance between ratings of constructs and elements in multidimensional space. Because PCA is built into many of the software packages for analyzing repgrids, it is the most common method of performing exploratory quantitative analyses on repgrid data. However, MDS is designed to examine spatial distances between grid ratings, which can be easily performed using statistical packages such as SPSS or SAS [Bell 1994; Bell 1997; Bell 2003; Van der Kloot 1981]. As a result, MDS is gaining popularity as a technique to analyze repgrid data graphically.

Conceptual Mapping

Phythian and King [1992] use conceptual mapping in their construction of a decision-based system for evaluating tender enquiries. After performing a cluster analysis with two experts, the analysts map the statistically strongest relationships and discuss the maps with the two experts. The mapping process has three advantages. First, it confirms and fleshes out the relationships with the user. Second, it allows the depiction of causal relationships. Third, it can help the interviewee think of other important relationships that might have been overlooked during the primary elicitation process. The individual maps are then negotiated between the two experts, and a single map is created.

Logical Analysis

Cluster analysis, PCA, and MDS are distance-based methods. In other words, they reveal the degrees of relative equality between and among elements and constructs by calculating the statistical distance between them.

Logical analysis, in contrast to the distance-based methods, seeks to identify not only the degree of equality but also the directional implications between and among elements and constructs. In the analysis of repgrids, this technique involves the quantitative identification of logical, inductive relationships among constructs and elements. In the field of IS, these directional implications are useful for revealing relationships within repgrid structure that can be directly translated into machine-readable logic for rapid prototyping of knowledge-based systems [B. R. Gaines 1993]. Asymmetrical relationships also give researchers a way of assessing one-way relationships without resorting to laddering or implications grids [Bell 2004].

Distance-based analyses of a grid that are designed to elicit information for a system supporting a decision to use one program over another, for example, might show the correlation (degree of relative similarity) between the constructs *Web based–stand alone* and *slow–fast.* Logical analysis can deepen the researcher's understanding of this relationship by suggesting its direction—that stand alone entails fast, but that fast does not necessarily entail stand alone. By looking at a repgrid, we know that all stand-alone applications are fast. However, one Web-based application—Gmail—was also fast. Stated technically, the right-hand pole (RHP) rating of the *Web based–stand-alone* construct on all elements necessarily leads to an RHP rating of the *slow–fast* construct for all elements. However, the opposite is not always true because a fast email application might be Web based. This asymmetrical relationship can be written as follows [Gaines and Shaw 1981, pp. 155-157]:

$$RHPm \supset RHPn$$

where m = *Web based–stand-alone* and n = *slow–fast.*

These logical relationships can also be transitive. If $LHPm \supset LHPn$ and $LHPn \supset LHPo$, then $LHPm \supset LHPo$ [Gaines and Shaw 1981].

The interpretation of these logical relationships forms the basis for expert and decision support systems created with the repertory grid. Figure 6 is a graphical representation of construct entailment and shows both asymmetry (one-way arrows) and equivalence (two-way arrows) in this participant's construct space. For a more in-depth look at how this logic can be analyzed in grids and be useful for the creation and prototyping of knowledge-based systems, see [Gaines and Shaw 1980].

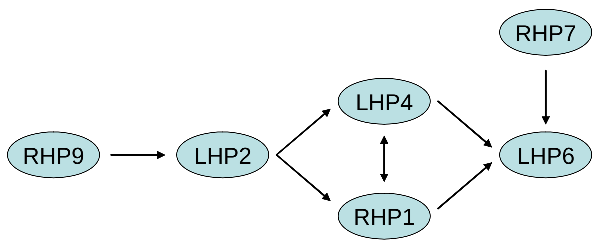

Figure 6. Graphical Representation of Construct Entailment, from [Gaines and Shaw 1980]

Asymmetrical logical relationships can also be explored using an uncertainty coefficient [Gaines and Shaw 1986], the phi coefficient, or a Proportionate-Reduction-in-Error measure (PRE) [Smithson 1987], as mentioned by Bell [2004].

Summary Measures

Beyond clustering, factor analysis, content analysis, and logical analysis, many repgrid software packages also offer a variety of summary metrics. Such quantitative measures assign numerical numbers to repgrids, often for comparison with other grids. Measures, such as Landfield's Ordination [Gallifa and Botella 2000; Landfield and Cannell 1988], Bieri's measure of cognitive complexity [Baldwin et al. 1996; Bieri 1955], or Gallifa and Botella's [2000] structural quadrants, sum up a repgrid in a small set of numbers. Similarly, construct or element measures such as discriminative power or extremity ratings can summarize various attributes of constructs and elements. These summary measures can be used to explore other relationships in the data and can inform future research.

Extending Analysis to Groups

Repgrid and Groups. The repgrid can be used to investigate understanding at the group level by identifying semantic areas of consensus, conflict, correspondence, and contrast [Shaw and Gaines, 1989]. Repgrids can be used in a group setting to elicit group constructs or to compare the constructs of individual group members with other team members.

PCT and Groups. PCT suggests that an individual's constructions are unique to that one person. However, PCT's commonality and sociality corollaries suggest that construct systems can be similar and individual constructs can be shared with others. In a study of the commonality of constructs, Latta and Swigger [1992] validated the repgrid's reliability and integrity for modeling communal understanding. They use a number of analyses to test the degree of similarity between students' construction of information relevant to the domain of information retrieval systems.

Analyzing Group Repgrids. There are three ways that repgrids can be analyzed in a group setting. The first way that a repgrid can yield group information is to have a single group complete a single repgrid whose elements and/or constructs have been identified by the group itself or by the researcher. Analysis of this single group-created grid can be performed using any of the techniques described above. However, because of the personal nature of constructs, conclusions and interpretations of a group's repgrid should be verified with the team and its individual members where possible [Easterby-Smith et al. 1996].

A second way of analyzing repgrids to acquire information from individuals, and then combine the grids into one single grid for analysis. An advantage of this type of group analysis is that ambiguities arising from the single group grid can be explored through deeper analysis of the single grids. An example of how grids can be combined is Phythian and King's [1992] case study of the development of an expert system. To facilitate this process, there are specialized repgrid software packages designed to perform cluster or factor analysis on multiple individual grids whose constructs and/or elements are the same. Of the packages referenced in Appendix II, IdeoGrid, Rep IV, and GridSuite each support some form of collective grid analysis.

Where the elements and/or constructs of multiple repgrids are not the same, they can be compared to the global measures mentioned previously. Multiple grids can also be analyzed by performing a content analysis on each and identifying or interpreting common emergent themes [Whyte and Bytheway 1996]. An additional way of observing trends across repgrids is to perform a frequency count of constructs. Those constructs that appear most frequently may be significant to a developed understanding of the knowledge domain [Boyle 2005; Whyte and Bytheway 1996].

Of course, other designs are possible. Wright [2002; 2004a] provided his participants with elements and, once they were done, aggregated their constructs and ratings into one grid, which was analyzed as a single group grid.

IV. POTENTIAL USES OF THE RGT IN IS RESEARCH

Having provided an overview of how the RGT is conducted and its many applications, we will now elaborate on how the RGT has been used in IS research in the past and how it may be applied in the future. IS researchers can apply the RGT to a variety of areas, bounded mainly by the research participant's domains of knowledge and perception [Hassenzahl and Wessler 2000]. The RGT is an effective tool for beginning to understand a problem [Chao et al. 1999], exploring the problem's scope, and subjectively evaluating a problem. It allows researchers to discover basic understanding of individual perceptions, meanings, and cognitive models that may be helpful in solving IS problems [Chao et al. 1999; Phythian and King 1992]. Additionally, the RGT has been shown to be useful as a tool to monitor changes in a participant's understanding or perceptions over time [Carlsson 1988].

Because of its focus on understanding and problem solving, the RGT has wide potential application in IS research. The most popular use of the RGT in IS literature has been from a design science perspective [Hevner et al. 2004] Specifically, the RGT has been used as a knowledge elicitation technique in the design of expert systems [Boose, 1989] and a variety of other systems [Byrd et al. 1992]. The RGT has also been used to help researchers understand users' mental models within the context of performing information storage and retrieval tasks [Dillon and McKnight 1990], as well as the cognition of those performing general systems analysis and design [Hunter 1994]

RGT in Decision-Based Research

Decision-based research using the RGT goes back at least two decades. Furthermore, as overviewed by Boose [1989], hundreds of decision-based systems have been created using the RGT. In Boose's overview, he suggests several uses for the RGT in creating decision-based systems, including creating decision aids, system development and delivery aids, group decision aids, online knowledge bases, project exploration and feasibility tools, teaching aids, expert system-building tools, and tools that provide situation insight [1989, p. 215]. Other examples of research using the RGT to create decision-based systems and to support knowledge acquisition for expert systems include [Castro-Schez, Castro et al. 2004; Castro-Schez, Jennings et al. 2004; Hwang 1992; Liou 1990; Phythian and King 1992]. More recently, research has proposed using the RGT to elicit buyer and seller information to support the creation of automated negotiation agents [Castro-Schez, Castro et al. 2004; Castro-Schez et al., 2005]. Finally, a recent study compared the efficacy and usefulness of the Kepner-Tregoe (KT) approach and the RGT as methods of eliciting decision criteria and alternatives for multi-criteria decision-making processes [Scheubrein and Zionts 2006]. They found that KT elicited more criteria, while the RGT elicited more alternatives. In addition, the repgrid was completed 33 percent quicker than the KT approach.

RGT in Information Storage and Retrieval Research

Information storage and information retrieval research has also benefitted from the RGT. The earliest study in this area used the RGT to explore how readers perceive different types of text, with the purpose of suggesting how to format and design electronic texts [Dillon and McKnight 1990]. Another used the RGT to model a querying user's view of relationships between types of documents [Bhatia 1992]. A couple of studies used the RGT for advancing information storage and retrieval of medical information [Jung and Gudivada 1995; Madigan et al. 1994]. Other notable RGT studies in information storage and retrieval research include [Bhatia and Deogun 1998; Bhatia and Yao 1993; Gudivada et al. 1994]. Finally, Xiangmin and Chingell [2001] investigated how educational and professional status, first language, academic background, and computer experience influence a person's mental model of information retrieval systems. They were able to classify different types of users, which is helpful in understanding each class's perceptions and needs in a system.

RGT in Systems Analysis, Design, and Development

Given the problem-defining and problem-solving nature of the RGT, it is perhaps not surprising that the most extensive application of the RGT in the IS literature has been in conjunction with improving systems analysis, design, and development.

Systems Analysis

In terms of systems analysis, the earliest study that we found used the RGT to acquire managers' most important sources of information [Grudnitski 1984]. Hunter [1994; 1998; 1997; 2000] performed several studies on different perceptions and assessments of the systems analyst, highlighting key perceptions [Hunter, 1994] and cross-cultural views [Hunter and Beck 2000] of the system analyst. These types of studies explore job descriptions to help systems analysts understand the social and behavioral aspects of other analysts within organizations. Another study explored the concept of IS fit with an actual system in the field to help the researchers understand and communicate to management what was perceived as wrong with the system and what was wanted from the system from stakeholders [Kanellis et al. 1999].

Design

In terms of design, one study used the RGT to rate design prototypes, which provided strong insights into design-relevant factors of user interfaces. [Hassenzahl and Wessler 2000]. Another study used the RGT to understand key aspects of user interface design on the Internet [Verlinden and Coenders 2000]. Finally, a study used the RGT to explore user-centered design evaluations of search engines [Crudge and Johnson 2004].

Development

In the systems development research domain, one study explored project risk planning from the vantage point of expert IS project managers [Moynihan 1996]. Another study examined extreme programming team membership roles using the RGT [Young et al. 2005].

Though research in these areas has been more extensive than other areas, the technique could help inform many of the analysis, design, and development topics that have yet to be addressed with the RGT. As an example, we illustrate the possibilities in using the RGT to develop organizational-level requirements.

Organization-level requirements define the broad strategy and infrastructure of the entire information system across an organization. They are broader in scope and less detailed than application-level requirements. Effective analysts consider organizational and policy issues when they analyze systems requirements [Davis 1982]. Organization-level requirements establish the overall portfolio of the organization's applications, dictate common communication interfaces across applications, specify the priority of application development, and set the structure of common data requirements.

In management, researchers use the repgrid to understand managers' models of cognition in a diverse and varied set of business units across the corporation [Ginsberg, 1989]. In that same arena, other researchers use the repgrid to model high- and low-performing managers' cognition of the overall strategy-making process [Wright 2004b]. Laddering is used to involve stakeholders in the identification of elements of IS structure that enhance performance and lead to accomplishing organizational objectives. Yet, little similar work has been done in IS.

Recognizing this opportunity, Tan and Gallupe [2006] recently used the repgrid to understand an aspect of business-IT alignment. They build on Reich and Benbasat's [2000] alignment literature, which suggests that alignment can be increased through shared understanding of business and IS executives. Tan and Gallupe [2006] use the repgrid to measure the relationship between business and IS managers' cognitive commonality and business-IS alignment. Their research finds that increased shared cognition between business and IS executives generally correlates with greater business-IS alignment. Still others have used the repertory grid to elicit user-perceived reasons behind a misfit of business needs and IT [Kanellis et al. 1999].

These studies suggest that PCT techniques in general and the repertory grid in particular could be useful in the development of organization-level IS strategy and alignment. The repgrid's ability to detect minute differences between alternatives could also help prioritize application development or help executives weigh the pros and cons of various enterprise-wide system configurations and strategies.

Other IS Research Using the RGT

Aside from the aforementioned IS research areas, IS researchers have found several other creative areas of RGT application. One study examined how users perceive the success of information systems in terms of an organization's developed systems [Whyte and Bytheway 1996]. Another used the RGT to explore user attitudes toward technology [Frewer et al. 1998]. Another showed how the repgrid can be helpful in exploring cognition in information systems research [Tan and Hunter 2002]. Clases et al. [2003] used the RGT to explore the subjective meaning of trust in two Swiss virtual organizations, which knowledge was used to improve a survey they were constructing. Oppenheim et al. [2003] used the RGT to elicit from top managers their personal views of information assets. The RGT has also been used to explore Web site evaluation criteria [Tan and Tung, 2003], analyze Web sites [Hassenzahl and Trautmann 2001], and measure Web site appeal [Wessler and Ortlieb 2002]. Boyle [2005] suggests using the RGT to elicit from various IT team members (e.g., programmers, technical specialists, IT managers) the desirable and undesirable traits of other team members in various positions in order to improve team performance. Finally, in a recent article, Davis and Hufnagel [2007] chose to use both the RGT and PCT to provide insights about the individual meanings of fingerprint technicians around a technical automation project.

Other Potential applications of the RGT in IS Research

In addition to the aforementioned applications of the RGT in IS research, we believe there are several additional potential uses for the RGT in IS research, including modeling of practitioner problems, building taxonomies, understanding group conflict, surveying information space, verifying or validating constructs, instrument development, and theory building or hypothesis testing.

Communication of Requirements

One potential novel use of the repgrid in IS research is to use it to communicate results of requirements determination with stakeholders and other analysts, because the repgrid can be an effective communication medium. In fact, Kelly's [1955] own original use of the repgrid—eliciting and then communicating back to the patient his or her perception of elements and constructs—suggests that communication may be a primary advantage of the finished or analyzed repgrid. Although we know of no empirical studies that specifically test the repgrid's ability to represent information effectively with stakeholders, Verlinden and Coenders [2000] suggest that the ease with which repgrid data is transformed into visual diagrams makes the repgrid "one of the best ways to communicate user experiences to all stakeholders in the development of web sites" (p. 144). Other research also shows that the repgrid is an efficient tool for normalizing and standardizing a group's vocabulary, which enhances communication [Shaw and Gaines 1989]. Future research could explore the effectiveness of the repgrid in representing the results of the determination of requirements to other analysis or to key stakeholders.

Modeling of Practitioner Problems

The repgrid provides a way for a researcher to analyze, decompose, and further understand a problem [Eden and Jones 1984; Poulymenakou et al. 1990]. It can be "used to represent what people know about problems" [Poulymenakou et al. 1990, p. 187]. The technique is also effective for defining and organizing semi-structured or ambiguous problems [Scheubrein and Zionts 2006], because it is useful in eliciting tacit knowledge that a person being interviewed cannot easily articulate [Shadbolt and Milton 1999].

Building Taxonomies

Whether one is trying to classify facial features [Gudivada et al. 1994], medical documents [Madigan et al. 1994], or electronic texts [Dillon and McKnight 1990], the repgrid forces the research participant to verbalize similarities and differences between elements. This can be helpful in classification or taxonomy building, which is increasingly common in IS research.

Understanding Group Conflict

A researcher can use the repgrid to help resolve conflicts or bridge gaps in understanding by eliciting mental models of a particular domain from multiple individuals and then comparing those models [Wright 2002]. This process reveals the sources of conflicts and can help to resolve them. This could be particularly helpful in collaboration, group, and computer-mediated communication research in IS, where interpersonal conflict can be a tremendous source of group process losses. Similarly, the RGT could be used to better understand group mental models, group processes, consensus, and so forth.

Surveying Information Space

Information space, or "the objects (real or virtual) to which the individual turns to acquire information" [McKnight 2000, p. 730], can be modeled through repgrid interviews [McKnight, 2000]. In the aforementioned study [McKnight 2000], the RGT was used to understand the interviewee's personal construct system related to the online and offline sources of information (e.g., email, newsgroups, electronic journals, conferences). Understanding an individual's meanings associated with different sources of information may be useful in understanding the cognitive stopping rules [Browne et al. 2007] associated with information search activities. The personal constructs that provide meaning to artifacts in an individual's information space may also be helpful in understanding how individuals make conclusions regarding the reliability of information encountered within an information system.

Verifying or Validating Constructs

The repgrid is an efficient tool for researchers who need to generate user-centered constructs. User-centered constructs can be compared to established and commonly employed constructs in order to identify gaps in the literature or deficiencies in established constructs' abilities to measure the intended phenomenon correctly [Crudge and Johnson 2004; Whyte and Bytheway 1996; Wright 2004b]. While this approach has been utilized in other fields, the use of RGT for construct creation is rare in IS.

Instrument Development

The RGT may be used fruitfully to help generate questions for survey instruments. Generating scale items from subjects may help overcome the problem of researcher bias that often results in scale development [Hallsworth 1988]. A researcher using the RGT can gather information on important aspects of a particular domain that can inform questionnaire development. This approach has been suggested in education [Lambert et al. 1997], social work [Hutchinson 1998], and health care research [Stewart et al. 2003] and could be used to strengthen the validity of IS survey instruments.

Other RGT Research Issues and Future Directions

Aside from the above areas of potential research, there are several other research issues with the RGT that are highly pertinent to IS researchers. Researchers have created many different ways of implementing repgrid techniques. Although the flexibility of the technique lends itself to a wide range of situations, such a wide range also makes comparison and verification of results difficult. We have discussed how researchers used the RGT in design science and other IS research. Studies suggest that various techniques are best suited to specific domains [Byrd et al. 1992] or different types of knowledge [Chao et al. 1999]. Hence, there is a need for more research on the optimal use of the RGT in various IS research domains and for eliciting specific types of knowledge.

Liou [1990] suggested that a researcher could use a combination of techniques to elicit knowledge and that the repertory grid is a useful supplementary technique. Chao, Slvendy et al. [1999] similarly suggested that different knowledge elicitation techniques could be combined for larger coverage of a knowledge domain. Along these same lines, Byrd et al. [1992] suggested future research be done on the "synergistic effects of elicitation techniques" [p. 118]. Future research could also examine which techniques are best suited for combination with the repertory grid to maximize the amount of knowledge elicited in specific tasks.

Poulymenakou, Cornford et al. [1990] suggest that different types of managerial problems and decisions require different methods of problem construction. More specifically, they state that as problems evolve from the operational level to the tactical level and the strategic level, the methods of problem construction should correspondingly vary. Future research on the effectiveness of the repertory grid as a tool for IS problem construction could yield important insights.

Separately, since the results from many grids can be compared easily, the RGT can be useful for inductive theory building [Hunter 1994] via Grounded Theory [Glaser and Strauss 1967]. During the early stages of knowledge elicitation, the repgrid can help turn participants' attention to previously unexplored topics [Grudnitski 1984; Hassenzahl and Wessler 2000; King and Phythian 1992; Phythian and King 1992], and help explore objectives in fields of research that have not yet developed testable hypotheses [Clases et al. 2003]. Again, such applications are rare in IS research.

Moreover, future literature could explore RGT's ability to confirm theory-based hypotheses. To this end, future research could determine which perspectives and theories the repgrid best complements. They might suggest theories based on action-theory perspective (which states that human actions are driven by subjective meanings and by their interpretation of events, and that human action can be interpreted only in light of these perceptions). Or they might suggest theories based on the grounded theory perspective, the socio-technical perspective, and the service perspective of IS user satisfaction.

Finally, the RGT may also be useful in comparing the effectiveness of conceptual models developed using competing modeling grammars (e.g., ontologically clear vs. unclear) as a communication tool between the stakeholder and the analyst. RGT could thus be used as alternative comparison methodology as compared to instigating information recall or problem-solving tasks.

V. CONCLUSION

The repgrid technique is a useful and powerful method for understanding individual perceptions, meanings, and mental models. In this paper, we provided an accessible overview of the repertory grid technique, its underlying theoretical background, and specific procedures and issues that researchers should understand when utilizing the method. The RGT has been presented in an organized four-phase framework, and the options for executing the RGT in each of these phases have been reviewed. We have also provided a review of the extant IS research that employs the RGT and have suggested several areas of research that may benefit from use of the RGT. As increasing attention is given to the cognitive processes and the meanings construed by those who develop and use information systems, the utility of cognitive mapping approaches such as the RGT increases. It is our hope that the guidelines and suggestions featured in this tutorial will encourage further research to aid those scholars who are interested in rigorously employing the RGT to enhance their work.

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APPENDIX I. PCT: POSTULATE AND CORROLARIES

The table below explores in detail the main tenants of PCT—its fundamental postulate and selected supporting corollaries.

Name	Kelly's Exact Wording [Kelly, 1955]	Explanation	Example	Implication for RepGrid/Application
Fundamental Postulate	The ways in which a person anticipates events psychologically channels that person's processes.	A person's behavior is driven by the way in which he/she anticipates events or objects.	n/a	n/a
Construction Corollary	A person anticipates events by construing their replications.	A person anticipates events and other objects in the world by interpreting the repetitions of past events.	A meeting is an event that one might anticipate. No two meetings are the same, yet past meetings help us understand the general attributes (constructs) that define future meetings.	A repgrid represents the specified domain as it is in the participant's mind, based on experience, not as it could, should, or will be.
Individuality Corollary	Persons differ from each other in their construction of events.	Persons differ from each other in their interpretation of events or objects. Two people may view the same thing in different ways, because they construe (interpret) the event differently (i.e., they use different constructs to identify it).	An information source might have meaning for one employee that is not shared by other employees. To one employee, the source could be helpful and succinct, and to another it could be confusing.	Each repgrid participant could use different constructs or different labels for the same constructs on the same elements. Constructs are best elicited by the user. Grids should be administered individually
Organization Corollary	Each person characteristically evolves, for their convenience in anticipating events, a construction system embracing ordinal relationships between constructs.	To conveniently order and anticipate events, a person creates a construction system over time. Constructs in this system can have a hierarchal relationship.	*Web mail and stand-alone mail* could be subordinate constructs of a higher *email system* construct, which along with *instant messaging* may be subordinate constructs of the higher *communication systems* construct, etc. All of these constructs and their relationships evolve over time and make up a construct system.	Laddering can be useful in the exploration of construct hierarchies. If participants verbalize their thought process while discriminating between elements, the researcher can make notes of hierarchies of elements.
Dichotomy Corollary	A person's construction system is composed of a finite number of dichotomous constructs.	A person's construction system is composed of a finite number of bipolar constructs. Constructs are bipolar because nothing in context is affirmed without denying something else.	There are only so many constructs that can be used to distinguish events email programs. If speed were an attribute of email programs, its dichotomous corollary might be the construct *fast-slow*.	Constructs must be bipolar.
Range Corollary	A construct is convenient for the anticipation of a finite range of events only.	A construct is *useful* for the anticipation of a finite range of events only. The finite range is dictated by the organization and permeability of the construct.	The construct of *threaded conversations–individual emails* is useful only (convenient) if it is used in the context of email	Rated elements should all belong to the same range of convenience. If the range is too large, the constructs become nonsensical.

Name	Kelly's Exact Wording [Kelly, 1955]	Explanation	Example	Implication for RepGrid/Application
			systems. This construct does not make much sense when applied to other elements such as word processing software. The range of *threaded conversations–individual emails* is narrowly limited.	
Experience Corollary	A person's construction system varies as they successively construe the replication of events.	People modify their construct systems with experience. As people learn, their construct system changes to align itself with what they interpret to be objective reality.	The initial introduction of a new type of email system might meet with resistance initially, until a person's construct system makes room for new constructs that are used to identify and evaluate the new system.	Repgrid is a good measure for longitudinal studies to find changes in perceptions.
Modulation Corollary	The variation in a person's construction system is limited by the permeability of the constructs within whose range of convenience the variants.	Permeability refers to a construct's ability to accept other constructs into its range of convenience. As new variations in a person's world arise, the variation must be defined by already-available constructs. The less permeable a person's construct system is, the more it varies.	The range of convenience for the construct *threaded conversations–individual emails* encompasses email programs, but does not extend to much else. However, the construct *fast–slow* can certainly be applied to many other areas, and its range of convenience is therefore larger. If we encounter a new software program (variant), it may lie within the range of convenience of permeable constructs like *fast–slow* but not within the range of convenience of the less permeable constructs. The less permeable a person's construct system is, the more it varies.	Some constructs may be applied to different contexts to gain additional insight, but others will be limited to a single context.
Fragmentation Corollary	A person may successively employ a variety of construction subsystems, which are inferentially incompatible with each other.	Construct subsystems that seem incompatible with each other at first can be compatible if higher-level construct subsystems are taken into consideration.	A person is entertained by violence in a movie, and then be deeply disturbed by violence toward his own person. The two concepts of violence may be inferentially incompatible unless consideration is taken of the higher constructs of *entertainment* and *reality*.	These help the person transcend contradictions in their logic.
Commonality Corollary	To the extent that one person employs a construction of experience that is similar to that employed	To the extent that two people use the same constructs to distinguish between events, their psychological processes	Two people who both view the payroll process as the same set of functions to attain a set of goals will, in regards	If two people share the same constructs (note: constructs differ from labels), their views can be compared.

Name	Kelly's Exact Wording [Kelly, 1955]	Explanation	Example	Implication for RepGrid/Application
	by another, their processes are psychologically similar to those of the other person.	and behavior will also be similar for that event.	to these constructs, behave similarly toward the process. The reverse is also true.	
Sociality Corollary	To the extent that one person construes the construction process of another, they may play a role in a social process involving the other person.	A person can relate to others without employing their same construct system. The understanding (construal) of others' construct systems allows a person to be involved with and relate to them.	Employee A may not view the payroll system in the same way as Employee B, but to the extent to which Employee A can understand Employee B's construction of the system, the Employee A can relate to Employee B on the construct of the system.	Sharing grids in a group setting and resolving differences between constructs can lead to mutual understanding and greater collaboration between group members.

APPENDIX II. REPGRID SOFTWARE FOR ELICITATION AND ANALYSIS

Package Name	Platform	Cost	Web site
FlexiGrid		CA $300	finn.tschudi@psykologi.uio.no
Chris Evans' SAS Analysis Program	Win	Free (SAS Required)	http://www.psyctc.org/grids/default.htm
Rep IV	WinXP/OSX	Personal: FREE Research: US $700	http://repgrid.com/RepIV/
OmniGrid	DOS/MAC	Free	http://www.psyctc.org/grids/omnigrid.htm
GridStat	DOS	Free	http://www.repgrid.unimelb.edu.au/grids.htm
GridCor	WinXP	Individual: €150 Institution: €240	http://www.terapiacognitiva.net/record/
IdioGrid	Win95-XP	Free	http://www.idiogrid.com/
GridScal	DOS	Free	http://www.repgrid.unimelb.edu.au/grids.htm
EnquireWithin	Win	US $49	http://www.enquirewithin.co.nz/
GridSuite	Win/Mac (Java)	Individual: €15–460 Site: €920	http://www.uni-stuttgart.de/pae/gridsuite/index.php
WebGrid III	All (Internet)	Free	http://tiger.cpsc.ucalgary.ca/
The latest information on these packages can be found at http://www.pcp-net.de/info/comp-prog.html. Prices and versions change often.			

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