Toward Improving the Validity and Reliability of Media Information Processing Measures in Surveys

Christian Schemer, Jörg Matthes, and Werner Wirth
Institute of Mass Communication and Media Research
University of Zurich

March 2008

TO APPEAR IN: COMMUNICATION METHODS AND MEASURES, 2(2), 2008
AUTHOR INFORMATION

Christian Schemer (corresponding author)
Institute of Mass Communication and Media Research, University of Zurich
Andreasstrasse 15, CH-8050 Zurich, Switzerland
Phone +41 44 635 20 74, ch.schemer@ipmz.uzh.ch

Jörg Matthes
Institute of Mass Communication and Media Research, University of Zurich
Andreasstrasse 15, CH-8050 Zurich, Switzerland
Phone: +41 44 635 20 76, j.matthes@ipmz.uzh.ch

Werner Wirth
Institute of Mass Communication and Media Research, University of Zurich
Andreasstrasse 15, CH-8050 Zurich, Switzerland
Phone +41 44 635 20 79, w.wirth@ipmz.uzh.ch

BIOGRAPHICAL NOTES

Christian Schemer (MA, University of Mainz) is a Ph.D. student at the Institute of Mass Communication and Media Research, University of Zurich, Switzerland. His research focuses on the process of public opinion formation, media effects, and empirical methods.

Jörg Matthes (PhD, University of Zurich) is a Post-doc at the Institute of Mass Communication and Media Research, University of Zurich, Switzerland. His research focuses on the process of public opinion formation, media effects, trust in news media, and empirical methods.

Werner Wirth (PhD, University of Leipzig) is professor for communication and empirical media research at the Institute of Mass Communication and Media Research, University of Zurich, Switzerland. His research focuses on media effects, entertainment, media and emotions, interactive media, and empirical methods.

Correspondence concerning this article should be addressed to Christian Schemer, Institute of Mass Communication and Media Research, University of Zurich, Andreasstrasse 15, CH-8050 Zurich, Switzerland, Phone +41 44 635 20 74, ch.schemer@ipmz.uzh.ch
Toward Improving the Validity and Reliability of Media Information Processing Measures in Surveys

Abstract

Measuring media information processing strategies is of great value to the study of media effects in the field. However, researchers have raised concerns about the reliability and construct validity of previously used scales. Therefore, the aim of the present study is to make a methodological contribution by developing a standardized scale for measuring heuristic and systematic information processing. Based on existing research, we tested our measures of media information processing in three independent surveys. Results demonstrate the psychometric properties of the scale and its construct validity with respect to related constructs.

ACKNOWLEDGMENTS

This research was supported by a grant from the Swiss National Science Foundation as a part of the National Center of Competence in Research (NCCR) “Challenges to Democracy in the 21st Century”. Additional funding was granted by the Swiss Federal Office of Communications (OFCOM).
A vast body of research has grown in both psychology and communication science that implements dual-process concepts (see for an overview Chaiken & Trope, 1999). Among them, Petty and Cacioppo’s (1986) Elaboration Likelihood Model (ELM) and Eagly and Chaiken’s (1993) Heuristic-Systematic Model (HSM) are the most prominent. The roots of these models can be found in persuasion contexts of communication, and they have been successfully applied in communicative contexts in general. In the recent decades, researchers have developed instruments to assess individual differences in information processing (Aune & Reynolds, 1994; Cacioppo, Petty, & Kao, 1984) as well as measures to assess situational media information processing (Griffin, Dunwoody, & Neuwirth, 1999; Kosicki & McLeod, 1990; Eveland, 2005; Perse, 1990). Relying on these measures, scholars have demonstrated that mass media effects on audience members are contingent on their mode of information processing.

Without doubt, communication researchers have laid the groundwork for an externally valid assessment of information processing in survey studies. Thus, based on self-report measures, they have shed light on different information processing strategies audience members rely on. Specifically, these measures have been useful in enhancing the predictive power of media effects models. As in experimental research in the laboratory, knowing how people process mass mediated information helps to explain the effects of mass media content on knowledge, judgments, and attitudes. For instance, a more elaborate mode of media information processing has been shown to enhance political learning (Eveland, 2001), participation in deliberative forums (Sotirovic & McLeod, 2001), higher risk judgments (Trumbo, 2002), and it produces a higher number of strongly held beliefs (Griffin, Neuwirth, Giese, & Dunwoody, 2002). In contrast, a more superficial mode of media information processing impedes learning from the news (Eveland & Dunwoody, 2002; Kosicki & McLeod, 1990), causes lower risk judgments (Trumbo, 1999), and lowers evaluation strength in audience members (Griffin et al., 2002).

Although scholars went to great lengths to provide evidence for the intervening role of information processing in media effects models, some of them have expressed serious methodological concerns. A first concern refers to low reliabilities in existing research. The reliability coefficients (Cronbach’s alpha) of previously used information processing measures vary considerably between .43 and .90. Therefore, some authors have called for the development of a more reliable measurement tool (Eveland, 2001; Griffin et al., 2002; Trumbo, 2002).
A second concern refers to the dimensionality and structural validity of existing measures. The structural validity indicates whether the structure of observables is consistent with the internal structure of a theoretical construct (John & Benet-Marínez, 2000). In early survey studies, three different strategies of media information processing are assumed (Kosicki & McLeod, 1990). Later, two dimensions of information processing were found using similar items (Eveland, 2005). Likewise, Griffin and colleagues (2002) also distinguished two strategies of media information processing in the domain of risk communication. Similarly, Aune and Reynolds (1994) provide evidence for a two-dimensional view in their studies on normative differences in information processing. Finally, the Cognitive Mediation Model (Eveland, 2001) postulates only one single dimension of media information processing. However, some studies failed to empirically reproduce the postulated structure of constructs with their data (e.g., Eveland, 2005; Griffin et al., 2004).

A third concern refers to the statistical association of existing measures of media information processing to related constructs. In some studies, unexpectedly, information processing measures did not correlate with related constructs, e.g., motivation, ability, or knowledge (Eveland, 2005; Johnson, 2005; Kahlor, Dunwoody, Griffin, Neuwirth, & Giese, 2003). Even more puzzling, some studies produced significant correlations of information processing measures with related constructs that were in the wrong direction (Eveland, 2005; Griffin et al., 2004; Trumbo, 2002). This problem concerns the criterion or external validity of a measure, because a construct is validated against an external criterion.

Historically, there are different approaches to validity. For instance, Cronbach and Meehl (1955) suggested four types of validity: content, predictive, concurrent, and construct validity. Content validity refers to the extent to which items as indicators of constructs are representative of the universe of items in the content domain of a construct. Predictive and concurrent validity are criterion-oriented in the sense that constructs require an external (actual or future) criterion against which they can be validated. Finally, construct validity refers to the demonstration that a researcher has really measured a specific construct and nothing else. Later, Messick (1995) proposed subsuming these aspects as important ingredients of construct validity. Therefore, we treat structural and criterion validity as subtypes of construct validity.

As a procedure to validate a measure or a test Cronbach and Meehl (1955) suggested a nomological network approach. According to this approach “to validate a claim that a test measures a construct a nomological net surrounding the construct must exist” (Cronbach & Meehl, 1955, p. 291). Such a network consists of laws or theories concerning the function or the
structure of a construct. These laws can involve the relations of observables to each other, the relations among theoretical constructs, or the relations of theoretical constructs to observables. Findings that are not consistent with these laws require a modification of the nomological network.

Transferred to the methodological problems listed before, inconsistencies in establishing construct validity (i.e., structural and criterion validity) can be considered as inconsistencies of a nomological network surrounding the information processing construct. As a consequence, additional research is needed that demonstrates construct validity more convincingly. Although scholars have acknowledged these methodological shortcomings (i.e., reliability and construct validity), they have not directly addressed them in their studies. Therefore, our research aims at filling this methodological gap. More specifically, we consider the reliability and construct validity of existing media information processing measures in more detail. In doing so, we concentrate on aspects of reliability, and structural and criterion validity as subtypes of construct validity.

In the present study, we adopt a nomological network approach to improve the psychometric properties of measures of media information processing. An even more sophisticated way to establish construct validity represents the multitrait-multimethod matrix procedure (MTMM; Campbell & Fiske, 1959). In short, the MTMM approach establishes convergent and discriminant validity simultaneously. Put differently, it can be demonstrated that different measures of the same construct are more strongly correlated than measures of different constructs using the same and different methods. However, this procedure involves analytical steps that go beyond the scope of our approach because MTMM not only takes into account that measurement buries random error but also error variance that is due to the method used in a study. Therefore, the MTMM procedure necessitates at least two different methods of measurement. To achieve the aim of our study, that is, to improve the reliability and construct validity of existing information processing measures, a nomological network approach is sufficient and is easier to realize.

The remainder of this article is structured as follows: To begin, we discuss recent methodological problems in more detail. Then, based on previous studies, we propose a refined measure of information processing for survey research and demonstrate its psychometric properties in three successive studies. These studies were especially designed to develop a standardized, reliable, and validated scale for measuring information processing strategies for communication research.
Problems of Meeting Conventional Criteria of Reliability

The first methodological shortcoming involves low reliability coefficients of information processing measures. Although in some studies reliabilities (Cronbach’s alpha) were .70 and higher, other studies obtained insufficient coefficients of .50 and lower (e.g., Eveland, 2001; Johnson, 2005; Kahlor et al., 2006; Trumbo, 2002; see also Table A1 in the appendix). Griffin et al. (2004) acknowledge this problem, arguing that the reliability of measurement must be improved in future studies. Kahlor et al. (2006) also mention low reliabilities as a shortcoming of their study. We can find several reasons for low reliabilities. A primary cause is the use of items that differ in meaning. For example, some studies measure heuristic information processing in using both processing items and items referring to a specific judgmental heuristic, e.g., an expert heuristic (Griffin et al., 2004; Trumbo, 1999; 2002). Such a scale is likely to bury large amounts of error variance. Table A1 reveals another reason for low reliabilities; that is the number of items used to measure the construct. This fact points directly to the advantages and disadvantages of relying on Cronbach’s alpha as the chief reliability coefficient. The advantage of coefficient alpha certainly is that it is easy to compute in conventional statistical software packages. Moreover, it provides an acceptable lower-bound estimation of reliability of a measure. However, without taking dimensionality into account the use of coefficient alpha may give rise to serious misinterpretations (Shevlin, Miles, Davis, & Walker, 2000). For instance, in a study by Johnson (2005) six items were intended to measure two dimensions of information processing (three items per dimension). Interestingly, a single index of six items showed a higher reliability than two distinct indices with three items per factor. Thus, this reliability coefficient does not inform us about what to do in such conflicting situations.

Several studies show that the reliability of a scale can be high when the correlations among items indicate a two-factor model (Schmitt, 1996; Shevlin et al., 2000). Even more important, Shevlin and colleagues (2000) provide evidence for results that might appear counter-intuitive at first glance: On the basis of Monte Carlo simulations they demonstrate that coefficient alpha can increase when a scale deviates from unidimensionality. The reason is that with larger sample sizes systematic measurement error is likely to produce higher levels of alpha. However, recent studies cannot sufficiently deal with this problem because they did not put their scales to a direct test in CFA, but relied on PCA or EFA (e.g., Eveland, 2001). Thus, when only coefficient alpha is reported without a direct test of dimensionality, results should be interpreted very cautiously (Shevlin et al., 2000).
Taken together, the lack of reliability has not led to systematic research with the goal of optimizing existing measures. Apparently, low reliability scores are acknowledged, but they have been treated as a minor problem. In most instances the opinion prevails that low reliability coefficients or larger amounts of measurement error causes lower statistical relations than originally expected (e.g., Eveland, 2002; Griffin et al., 2002). Thus, true statistical relations are likely to be underestimated. However, it is equally possible that random and systematic measurement error produces parameter estimates that overestimate true statistical associations (Andrews, 1984; Blalock, 1970; Bollen, 1989, p. 175). Keeping this in mind, low reliability can cause serious problems to data analysis, especially when random and systematic measurement errors occur concurrently. Consequently, a misinterpretation of parameter estimates is likely (see Andrews, 1984). Therefore, the problem of low reliabilities should be considered with caution and should be directly addressed to further improve existing scales (Johnson, 2005).

**Structural Validity of Media Information Processing Measures: One, Two, or Three Modes?**

Apart from the reliability problem, another inconsistency emerges when previous studies are compared. This inconsistency refers to the structure or dimensions of the construct of interest. As already mentioned, we refer to structural validity as a subtype of construct validity. For instance, McLeod and colleagues (see Kosicki & McLeod, 1990 for an overview) proposed three different strategies of how audience members process mass media information. The authors labeled them *reflective integration*, *active processing*, and *selective scanning*. The first factor, *reflective integration*, refers to the audience’s ability to integrate media information in an existing knowledge structure (Kosicki & McLeod, 1990). The second factor, *active processing*, “reflects the audience member’s attempt to make sense of the story, going beyond the exact information” (Eveland, 2005, p. 221). The third factor, *selective scanning*, is a strategy that the audience uses to tune out pieces of information that are not of primary interest (Kosicki & McLeod, 1990). Several studies reveal that *reflective integration* enhances political learning from the media, while *selective scanning* hampers the acquisition of knowledge (Eveland & Dunwoody, 2002; Eveland, McLeod, & Horowitz, 1998). *Active processing* creates higher interest and stimulates participation in audience members.

In a review of previous findings, Eveland (2005) refers to some methodological shortcomings to demonstrate structural validity. More specifically, he argues that cross-loadings have caused serious problems in replicating a three-dimensional factor structure across
different studies. To be more precise, **reflective integration** and **active processing** seem to form one single factor labeled **active reflection** (Eveland, 2005; Eveland, McLeod, & Horowitz, 1998). Similar problems emerged for the items measuring **reflective integration** and **selective scanning**. For example, the item "I rarely spend much time thinking about the stories I read or hear about in the news" (reverse coded) was designed to measure **reflective integration**. However, in some studies this item loaded on the factor **selective scanning** instead (Eveland, 2005).

The findings discussed above reveal some difficulties in demonstrating structural validity. The same problems occurred in another stream of research—in the RISP, the Risk Information Seeking and Processing Model (Griffin et al., 1999). The RISP assumes two modes of media information processing: **systematic** and **heuristic processing**. Similar to **elaboration** or **active processing**, **systematic processing** is an effort-intensive way of engaging with media information. **Heuristic processing**, an information processing mode comparable to **selective scanning**, is a default mode and refers to a more superficial way of processing media information. In several studies, systematic processing leads to a higher number of strongly held beliefs (Griffin et al., 2002) and higher risk judgments (Trumbo, 1999) compared to heuristic media information processing.

Similar to the dimensionality problems discussed above, the factor structure of the information processing construct across studies is not as stable as it should be. For instance, a study by Griffin et al. (2004) found three factors. Particularly, the items intended to measure a single dimension of heuristic processing loaded on two different factors. To achieve a two-dimensional solution of heuristic and systematic processing, they forced the third factor into the second one. In a related study, Kahlor and colleagues (2003) found two dimensions of information processing, systematic and heuristic processing. However, the second factor showed an eigenvalue of .89. Eigenvalues lower than one indicate that the factor accounts for less variance than the items loading on this factor (Fabrigar, Wegener, MacCallum, & Strahan, 1999). Consequently, it is open to question whether a one-factorial solution fits the data better than a two-factor solution.

One reason for the emergence of inconsistent factor structures is the use of different items across studies or the steady change in item wording from one study to another (Eveland, 2005; Griffin et al., 2004). We collected the items of most of the previous studies. The item wordings are depicted in Table A2. The table clearly reveals that, on the one hand, there is no standardized scale that we can rely on. Only some of the items are used more than twice, and
very frequently new items are included. On the other hand, it becomes obvious that sometimes the same item is used to measure two different processes.

A second reason for problems with structural validity is the method to establish structural validity. Researchers have heavily relied on exploratory factor analysis (EFA) for the development of scales. Table A3 in the appendix depicts details on the factor analytic procedure of previous studies. As can be seen, some studies have used principal component analysis (PCA). Although EFA is more appropriate to examine the latent structure of observables compared to PCA (Bryant & Yarnold, 1995; Fabrigar, et al., 1999; Park, Dailey, & Lemus, 2002), it can be argued that there are better techniques to determine the dimensionality of latent constructs (Holbert & Stephenson, 2002; Levine, 2005; for recent examples Kohring & Matthes, 2007; Matthes, Wirth, & Schemer, 2007).

In EFA all items load on all factors, although there may be assumptions according to which specific items should load on a specific factor. Consequently, scholars have determined the factor structure empirically by different rotating procedures. Although most of these studies have extracted the assumed factors, a closer look reveals considerable differences in terms of eigenvalues, explained variance, and correlation between factors. One cause is certainly a lack of measurement reliability. However, other reasons may be sampling error or factor analytic methods that vary from study to study. Thus, the factor solutions found in previous studies may have been sample specific because without any theoretical assumptions EFA produces different factor structures in different samples. In retrospect, it is difficult to find the exact cause of different factor structures given that across studies not only the item wordings vary considerably, but also the number of items, the factor extraction method, or the factor rotation procedure. Although researchers have acknowledged methodological problems with measurement and dimensionality (e.g., Eveland, 2005; Griffin et al., 2004; Johnson, 2005), previous research has not addressed these problems properly.

Taken as a whole, to date no study has tested a measurement model explicitly. Here structure equation modeling (SEM) techniques such as confirmatory factor analysis (CFA) are more appropriate than EFA to test assumptions about the dimensionality of a construct (Bollen, 1989; Holbert & Stephenson, 2002; Levine, 2005; Noar, 2003). In CFA a measurement model has to be specified, and is then tested empirically. Typically, CFA is more appropriate when theoretical assumptions are at hand that pertain to the relations of observables and a latent construct. EFA, in contrast, is more useful when theory building is the aim of research (Bryant & Yarnold, 1995). Given that our knowledge on media information processing has matured during
the last decades, obviously CFA is more appropriate to test for structural validity. At the same time, CFA enables us to disentangle true score variance from error variance. In other words, problems with reliability and structural validity can be considered simultaneously.

Problems of Establishing Criterion Validity

Assessing media information processing strategies in the field requires the researcher to rely on self-report data from questionnaires. As information processing strategies are derived from answers to questions indicating the assumed processes, the researcher must demonstrate that he or she has really measured information processing strategies and nothing else. Such a demonstration refers to construct validity. There is a widespread agreement in the methodological literature that construct validation is the central concern in measurement (Bryant, 2002; John & Benet-Martínez, 2000; Messick, 1995). Without construct validating a measure, it is not clear whether the observed variables reflect the construct intended to be measured, a variety of other constructs, or just random error. In terms of a nomological network approach, construct validation can be established by validating a construct against an external criterion (Cronbach & Meehl, 1955). Previous studies have not demonstrated the criterion of their measures explicitly. However, we can derive criterion validity from the correlations of information processing measures with antecedent constructs or outcome measures. Specifically, studies in communication science have found that systematic processing is positively related to issue-specific interest, personal relevance, and information sufficiency as motivational forces (Eveland, 2005; Griffin et al., 1999; Johnson, 2005; Trumbo, 2002). The same associations were found for systematic processing with knowledge, subjective capacity to process information, or self-efficacy (Eveland, 2005; Griffin et al., 2004; Johnson, 2005) as ability indicators. The inverse pattern of results occurred for heuristic processing (see Table A3 in the appendix).

However, this table also reveals some mixed results. For instance, some survey studies produced zero-correlations or even negative correlations although positive associations were originally assumed (Eveland, 2005; Griffin et al., 2004). In a recent study, Griffin et al. (2004) failed to find a positive relationship between viewers’ abilities to gather information and systematic processing. Trumbo (2002) – although with somewhat different items – also failed to demonstrate a consistent relationship between ability and systematic processing. The same held true for motivation as a predictor of information processing (e.g., Kahlor et al., 2003; Trumbo, 2002). Trumbo (2002) argues that the failure to provide evidence for convergent
validity is due to the reliance on self-report measures. We do not concur with this argument. In contrast, we argue that the failure to establish construct validity is also due to the problems of low reliabilities and structural validity. For instance, the inspection of Tables A1 and A3 in the appendix reveals that unreliable measures of media information processing produce more inconsistent correlation patterns than reliable instruments. Thus, low reliabilities (e.g., due to different item meanings or due to the use of only two items) bury large amounts of measurement error biasing correlations with related constructs. It follows that we can provide more consistent evidence for criterion validity by improving the reliability and structural validity of measures.

Construct validity evidence also requires that the information processing strategies and antecedent conditions, such as ability or motivation, form distinct constructs. Factor analysis is one way to demonstrate discriminant validity (Bryant, 2002). For instance, when we assume a two-dimensional view of information processing related to a one-dimensional construct (e.g., issue specific interest), then we expect a three-factor solution in factor analysis. In contrast to this procedure, most commonly, previous studies have submitted items from different constructs to separate factor analyses instead of analyzing them together in a single step. With the exception of a few studies this aspect has been overlooked. Eveland (2001), for example, addresses the issue of discriminant validity explicitly. Relying on EFA, he assumed elaborate processing, surveillance gratification seeking, and news media attention to be statistically related, yet empirically distinct, constructs. Based on two data sets, he provides evidence for a three-factor solution despite critically high cross-loadings. A third study, however, failed to provide evidence for the postulated factor structure. Instead, attention and elaborative processing loaded on the same factor.

In other words, although information processing strategies are related to motivation and ability to process information, it must be shown that these measurements form distinct constructs. In previous research, such demonstrations are rare. Furthermore, as in the case of structural validity, a stricter test of discriminant validity would be a confirmatory test using SEM techniques to explicitly test “which items measure the same construct and which items measure different constructs” (Levine, 2005, p. 336).

To summarize, recent survey studies have provided substantial accounts of how information processing strategies intervene in media effects models. At the same time, these studies have continuously expressed the need for methodological improvement in order to develop more valid and reliable indicators. Therefore, to achieve high quality research, we have
to compensate for methodological concerns that have not been fully appreciated to date. Because measurement issues are at the heart of this stream of research, our aim is to make a methodological contribution to the field. More specifically, we investigate the psychometric properties of existing measures and propose a refined version of a measure of media information processing.

**Toward Refining Existing Instruments of Media Information Processing**

Building on previous research, we start with the assumption that a two-factor conception of media information processing is more appropriate than a one-dimensional or a three-dimensional structure. The review of studies summarized in Eveland (2005) demonstrates that a three-factor structure of media information processing often reduces to a two-factor solution. Thus, a three-dimensional view appears untenable. When we compare two-factor versus the one-factor view, parsimony speaks to the latter one. Why, then, not rely on the most parsimonious way to conceptualize media information processing? However, an answer to this question is not so easy because both perspectives do not only differ in terms of operationalization. These studies also differ with respect to the predicted outcomes. While studies using one-dimensional measures of media information processing predict learning, studies relying on two-dimensional measures predict judgments or attitudes. The lessons drawn from previous studies, thus, suggest that a single-factor model is sufficient when research focuses on the knowledge acquisition (Eveland, 2005). The reason is that the amount of mental effort is the most important explanation for why audience members learn from the media (Aune & Reynolds, 1994). This mental effort can be adequately measured with a one-dimensional bipolar scale ranging from low to high mental effort.

In contrast, when we predict judgments or attitudes, then not only differences in depth of processing are relevant but also additional factors (Wirth, 2006). More precisely, recent research has also emphasized differences in the nature of information entering the computation of a judgment, the underlying processing rules, or the sources of knowledge that are involved (for an overview see Sloman, 1996). Furthermore, neuroscientific research lends support to a two-systems view. Lieberman (2003) convincingly demonstrates that different regions in the brain are involved when individuals process information either in a heuristic or in a systematic way.
Although there is an ongoing discussion in social psychology regarding whether these processing strategies are really qualitatively distinct (Kruglanski, 2006), we see another reason why a two-dimensional view is more appropriate in the present context. In experimental settings subjects receive only one single exposure to a piece of media information. After the exposure the impact of this piece of media information is measured. In public opinion surveys, however, recipients are asked to report about several exposure episodes over several weeks. Within this time span recipients are likely to differ in their engagement with media information. In some episodes audience members process media information actively and attentively, while in other situations recipients do not find the time, or they lack the motivation to engage in systematic processing. As a consequence, they may want to get a general idea or impression of an issue. In a public opinion survey, then, these recipients would score high, both on items tapping the notion of systematic media information processing and on items assessing a more shallow engagement with media information. Although simultaneous heuristic and systematic processing is unlikely to be observed by a scale implemented in a survey, we can at least assume that individuals show variability in information processing over a period of time.

Taken together, we expect as a basic hypothesis that media information processing is made up by two-dimensions. When audience members process media information systematically, they invest a high amount of attention to make sense of media information (Eveland & Dunwoody, 2002), and focus on the argumentation of news, weighing the pros and cons and relating them to existing knowledge (Eveland, 2001; Griffin et al., 1999). When audience members process media information heuristically, they not only invest less effort but are also likely to focus on different pieces of information (Griffin et al., 1999). Put simply, audience members favor non-content cues relying more on inferential rules and cognitive heuristics (Eagly & Chaiken, 1993). This low-information strategy is used when motivation is low or processing capacity is constrained.

In contrast to previous studies, we address the issue of dimensionality directly by using CFA. Recent studies enable us to formulate explicit assumptions about the structural properties of information processing measures. In addition, we can test different models against each other. For instance, CFA enables us to test whether a two-dimensional model fits the data better than a one-dimensional construct (Noar, 2003).

The present research involves three steps. As a first step, we conduct a survey study with a convenience sample in order to test the dimensionality of the items used so far. This study serves as a preliminary test for the selection of items (Clark & Watson, 1995). The second
study tested selected items on the basis of a representative sample. This step represents a major stage in scale validation, because stability and replicability of a hypothesized construct is demonstrated best in more heterogeneous samples. The items are retested in a third study to bolster the robustness of our factor solution. Additionally, the third study aims at further demonstrating construct validity. A refined measure of media information processing should show better psychometric properties not only in terms of reliability and structural validity, but also in terms of criterion validity as another important aspect of construct validity.

Study I

Method

We started our study by collecting all items used in previous survey studies (see Table A2). Without being exhaustive, we chose those items that explicitly relate to the core of media information processing (Eveland, 2005). For the measurement of systematic processing, we selected the most commonly used items. However, items assessing heuristic media processing have caused more serious problems in recent research (Johnson, 2005; Trumbo, 2002). Previous studies have not only used items tapping the notion of a more cursory and superficial engagement with media content but also items relating to the use of judgmental heuristics, e.g., an expert heuristic (e.g., Trumbo, 1999). However, we do not include these items because people may rely on different heuristics when processing in heuristic fashion. Thus, as previous studies reveal, the inclusion of items referring to different heuristics would produce low reliability coefficients. In the next step, we removed double-barreled items and reformulated some of them slightly. In order to avoid overinclusiveness, we also considered items that performed not so well in previous studies but indicated the content of the media information processing concept.

In the first study, six items were used to assess systematic information processing, and five items were used to measure heuristic information processing. Table 1 depicts the items for the first and subsequent studies. The hypothesized relations of the items and the latent constructs were derived from previous studies. As some items have been shown to be serious double-loaders (Eveland, 2005; Griffin et al., 2004), we can derive concurrent assumptions about their loadings. Provided that a two-factor model is more appropriate than a single-factor model, we can test whether these items improve the overall fit of the model when they load on the heuristic or on the systematic factor.

[Insert Table 1 about here]
Sample

The items were included in a standardized questionnaire and applied in a Web-based survey from January to February 2005. Participants expressed their agreement with the statements intended to measure information processing strategies on five-point scales (1 for “do not agree at all” to 5 for “fully agree”). The survey dealt with attitudes toward the bilateral relations between Switzerland and the European Union. We focus only on the results of the information processing scales here. Participants of the study (N = 745, 47.8 percent female, range of age: 18-81 years, M = 33.58, SD = 13.67, nationality: German-speaking Swiss residents) were contacted by e-mail. We used a quota procedure to produce variability in education and age. Nevertheless, younger people (70 percent were younger than 40 years) and people with higher educational degrees are overrepresented.

Results

Our first analysis tests the structural validity of the items using CFA in AMOS 8.0. Full Information Maximum-Likelihood (FIML) estimation was used to estimate all models, as it has proven to be a useful procedure to treat missing values (Wothke, 2000). The average amount of missing values was below one percent. In order to evaluate the model fit, the following criteria were incorporated (Hu & Bentler, 1999): The $\chi^2$-value with the degrees of freedom (df), the Root Mean Square Error of Approximation (RMSEA) and its 90 percent confidence interval (90%-CI) were used as absolute fit indices. The Comparative Fit Index (CFI) and the Normed Fit Index (NFI) demonstrate incremental fit.

Compared to conventional cut-off criteria (Hu & Bentler, 1999), the result of the CFA reveals a poor fit of the model ($\chi^2 (34) = 329, p < .001, \text{RMSEA} = .10, 90\%-\text{CI}: .09-.12, \text{p-close} = .001, \text{CFI} = .88, \text{NFI} = .87$). The factor loadings and squared multiple correlations (SMCs) are shown in Table 1. As can be seen, most of the items performed well and with sufficiently reliable loadings on their respective information processing factors. However, four out of eleven items exhibit only moderate or even low SMCs. For example, SMCs of items a, i, and f are lower than .30. These items deteriorate the fit of the model considerably.

The inspection of the relationship between the latent factors indicates a relatively high correlation ($r = -.73$). Therefore, we tested whether a one-factor model fits the data better than the two-factor model. However, with a one-factor the fit worsened ($\chi^2 (35) = 656, p < .001, \text{RMSEA} = .15, 90\%-\text{CI}: .13-.17, \text{p-close} = .001, \text{CFI} = .75, \text{NFI} = .74$). To investigate whether
some items of the two-factor model mistakenly loaded on another factor, we conducted an EFA (principal axis extraction, oblique rotation). A two-factor solution occurred with reliable factors (systematic: Cronbach’s alpha = .80; heuristic: Cronbach’s alpha = .71). However, item \( i \) turned out to be critical: Although this item should load on the heuristic factor in CFA, it loaded on the systematic factor in EFA. To check whether the model fit in CFA improves, we analyzed the two-factor model once again with six items loading on the first factor and four items loading on the second one. That means the “problem item” loaded on the systematic factor in CFA this time. After this modification, the fit improves but it is far from acceptable (\( \chi^2 (34) = 252, p < .001, \text{RMSEA} = .09, 90\%-\text{CI}: .07-.11, p\text{-close} = .001, \text{CFI} = .91, \text{NFI} = .90 \)).

### Discussion

In the first study, the items to measure media information processing turned out to perform poorly when tested with CFA. Interestingly, an EFA produced an adequate two-factor solution as did previous studies (Eveland & Dunwoody, 2002; Griffin et al., 2002; Kahlor et al., 2003). In other words, the more conservative procedure produced an unacceptable fit. However, the EFA results indicate a necessary modification of the model. In the modified model, the fit does improve but is not acceptable compared to conventional criteria. Thus, the first analysis suggests the exclusion of several items to improve the model fit. However, this strategy is likely to be misleading for two reasons. On the one hand, fitting a model to a specific sample can produce a poor fit for an independent sample (Noar, 2003). On the other hand, the excessive removal of items from the original scale causes a loss of information and consequently a loss of content validity. In the literature on scale development, it is not recommended to enhance reliability at the expense of validity (Clark & Watson, 1995). Instead, the estimates of the items used in this first study inform us about specific modifications for an additional study. Therefore, we used the information from the preliminary study to improve the items for another one.

### Study II

For the second study, we made several modifications. First, the simplest modification was dropping two items, one from each scale, which exhibited low factor loadings. These items overlap in content with other indicators. Thus, these items provide little additional information to our scale. Second, another item loading on the systematic factor refers only to print media (item \( d \)). Audience members preferring TV instead may have disagreed when answering this item,
although otherwise, they might process media information systematically. Therefore, we broadened the meaning of this item by reformulating it (item e). Third, we reformulated one item of the heuristic factor to enhance clarity. The skewness of the item (1.29, five-point scale from 1 to 5) informed us that it was too difficult to agree with. Therefore, we formulated this item less restrictively (item k). Finally, we retained item f, although it showed a low factor loading. The reason was that it touched on aspects of media information processing not covered by other items. It refers to time restrictions in media use, and it has been shown to be important in previous studies as well (Eveland, 2001; 2005; Trumbo, 2002). In sum, we tested an eight-item measure (four items per dimension) for two-dimensionality.

Sample

The second study was a telephone survey (CATI) in the German-speaking part of Switzerland. In order to avoid order effects the questions were rotated at random. It was a representative sample (random quota) in terms of education, age, and sex (N=500; age: M=49.25, SD=17.13, 53 percent female; nationality: German-speaking Swiss residents). In contrast to our first study, the sample shows sufficient variety in the educational levels of the participants. The survey dealt with the issue of asylum policy in Switzerland. The eight items tested in this study can be found in Table 1.

Results

Again, we estimated the model with the FIML procedure. As the fit indices suggest, the model fit the data well (χ² (19) = 56.51, p < .001, RMSEA = .06, 90%-CI: .04-.08, p-close = .12, CFI = .96, NFI = .94). As can be seen in Table 1, the factor loadings are above .50, with the exception of two items scoring slightly below. The “problem item” of the first study now performs better. Thus, our decision to retain it for the present study proved to be justified.

The correlation between the latent factors (r=-.46) was significantly lower compared to the first study. Nevertheless, we tested a two-factor model against a one-dimensional model. As in the first study, the latter model achieves only a poor fit (χ² (20) = 162.32, p < .001, RMSEA = .12, 90%-CI: .10-.14, p-close < .001, CFI = .85, NFI = .84). This result strongly supports the validity of our scales and lends support to the assumption of two negatively correlated scales, one for systematic and another one for heuristic processing. The systematic factor represents the notion of an elaborate engagement with media information and an interest in specific details. The heuristic factor is made up of items that indicate a superficial way of media information
Toward Improving the Validity

Discussion

We have improved our measurement instrument from the first to the second study. Due to slight modifications and the use of a representative sample, an acceptable fit of our model resulted. Extending previous research, an explicit model test using CFA provided evidence for a two-dimensional structure. In a model comparison, the two-factor model exhibited a better fit than the single-factor model. So far, we have presented evidence for the structural validity and reliability of our measure. However, the scale needs further construct validation. For instance, we have to establish criterion validity in order to be sure that we have really assessed information processing strategies of audience members and nothing else. Therefore, in addition to a further test of the model, the third study aims at providing criterion validity.

Study III

Hypotheses

In order to establish construct validity, scholars have relied on demonstrating correlations with constructs, such as recipients’ ability and motivation to process media information. In terms of a nomological network approach, such a demonstration of construct validity refers to criterion or external validity (Bryant, 2000; Cronbach & Meehl, 1955; John & Benet-Martínez, 2000). Consistent with recent findings, systematic processing should be contingent on the higher motivation and higher ability of media users. When audience members lack either motivation or ability, heuristic processing is more likely to occur (Eveland, 2005; Griffin et al., 1999). Criterion validity was thus tested by correlating our information processing scales with those antecedent variables and outcomes that have been used in previous studies. To be more precise, we rely on motivation and ability as conditions of information processing and attitude strength as an outcome of information processing.

Additionally, and extending previous studies, the trait Need for Cognition (NFC) is used as a criterion for systematic information processing. We assume that systematic processing is more likely to occur when people are motivated and able to perform it. Consequently, in our first
two hypotheses we postulate a positive correlation between systematic processing and motivation (Hypothesis 1) and ability (Hypothesis 2). Conversely, we expect a negative relationship between heuristic processing and motivation and ability. Previous studies in the field have rarely examined the relationship between the NFC and media information processing (but see Aune & Reynolds, 1994). However, findings from experimental research suggest that high NFC is positively related to systematic processing (Petty & Cacioppo, 1986; see also Liu & Eveland, 2005). Therefore, we predict a positive correlation between NFC and systematic media information processing. Conversely, heuristic processing should be negatively correlated with NFC (Hypothesis 3).

Furthermore, we would like to enhance construct validity by demonstrating statistical relations to variables that do not rely on self-report data. For instance, Johnson (2005) has also called for studies using external criteria to validate information processing scales in the field. Recently, Griffin and colleagues (2002) validated their measure of information processing relying on objective data. The authors assumed systematic processing to enhance evaluation strength and heuristic processing to hamper it. In the study by Griffin et al. (2002), evaluation strength was assessed by recoding belief or attitude items into high, moderate, and low evaluation strength. Evaluation strength is a more objective measure than directly asking interviewees for evaluation strength. As expected, they demonstrate that systematic processing produced stronger beliefs compared to heuristic processing. Evaluation strength has also been referred to as attitude strength (Krosnick & Petty, 1995). Therefore, we assume that systematic processing leads to stronger attitudes compared to heuristic processing.

Another stricter way to construct validation is to show statistical associations with more objective data, e.g., response time of self-report. A consistent finding in research is that systematic processing produces not only stronger attitudes but also faster responses to attitudinal items (e.g., Fazio & Williams, 1986). Response latency data have been recognized as an important indicator of mental processes, such as information processing strategies. Furthermore, response time measures have also been used in public opinion surveys (Bassili, 2003). Therefore, we assume that systematic media information processing produces not only stronger attitudes but also faster responses to attitudinal items. In sum, we hypothesized to find positive correlations between systematic processing and attitude strength. This relationship should be obtained with subjective self-report measures, such as attitude certainty (Hypothesis 4), which reflects the subjective feeling of attitude strength, but also with operative measures
such as attitude extremity (Hypothesis 5). Finally, the relationship should occur for objective measures such as the time to report attitudinal judgments (Hypothesis 6).

The demonstration of discriminant validity requires us to show that our information processing measures and related measures (i.e., ability, motivation, NFC, and attitude strength) form different latent constructs. Our hypothesis is that the distinctness of both information processing strategies and their related constructs can be established in a confirmatory way (Hypothesis 7).

Sample

The third survey study dealt with the issue of asylum policy. Another independent sample was recruited by random quota at the end of September 2006 ($N = 892$, age $M = 48.53$, $SD = 17.59$; 50.1 percent female; nationality: German-speaking Swiss residents). Again, the questionnaire was programmed for an application of CATI (Computer Assisted Telephone Interview), and the questions were rotated at random.

Measures

The items assessing systematic and heuristic media information processing remained the same as in the second study. The antecedent variables were operationalized as follows: Motivation was operationalized as personal and social relevance of the issue and was assessed by two items similar to previous studies (“The issue is quite important to me personally” and “The issue is quite important for our society,” five-point scales: 1 for “disagree” to 5 for “agree”). Both items were highly correlated ($r = .50$). Ability was operationalized as a single-item measure of self-reported ability to follow the discourse of the issue in society (“I feel capable of finding the relevant information that I need”). The response format was similar to the motivation items. NFC was assessed with four items from the original NFC-scale (Cacioppo, Petty, & Kao, 1984; Cronbach’s alpha = .70).

Attitude strength was operationalized in three different ways (see Wegener, Downing, Krosnick, & Petty, 1995). First, we used a self-report scale of attitude certainty. After completing their overall attitude toward asylum policy, respondents answered how certain they were of their attitude (1 for “not certain” to 5 for “very certain”). A variable for attitude extremity as an indicator of attitude strength was computed, by convention, as an index of extremely positive and negative answers to the central attitude questions (Wegener, et al., 1995). Response latency was assessed automatically in the CATI interview. Particularly, we assessed the time (in seconds) it took the interviewees to report their attitudes.
Results

Model Fit

In a first step, the estimation of the two-factor model of media information processing produced a good fit ($\chi^2(19) = 52.64, p < .001, \text{RMSEA} = .06, 90\%-\text{CI}: .04-.08, \text{p-close} = .25, \text{CFI} = .98, \text{NFI} = .97$). The factor correlation was slightly higher than in the second study ($r=-51$). The estimates in Table 4 denote slightly better psychometric properties in terms of factor loadings and SMCs compared to the second study. This lends further support to the reliability and structural validity of our measure. Similar to study I and II, a test of a one-factor model proved a worse fit to the data ($\chi^2(20) = 563.27, p < .001, \text{RMSEA} = .22, 90\%-\text{CI}: .21-.24, \text{p-close} < .001, \text{CFI} = .64, \text{NFI} = .63$). This result indicates a better fit of a two-dimensional model than a one-factor solution.

Hypotheses Testing

In the second step, we tested our assumptions concerning the criterion validity of our measure. The first hypotheses stated that the motivation and ability to process information as well as NFC are positively correlated with systematic processing. An inverse correlation pattern should occur for heuristic processing with these variables. Table 2 exhibits the correlations among all constructs. As expected, systematic processing is positively related to ability, motivation, and NFC. In contrast, heuristic processing is negatively related to these antecedent conditions. These results confirm hypotheses 1 to 3.

As can also be seen, the attitude strength measures (attitude certainty, attitude extremity, and response latency) correlate as predicted with our information processing scales. Thus, systematic processors score higher on attitude certainty and attitude extremity compared to heuristic processors. At the same time, they respond faster to the attitudinal items in the questionnaire. These results confirm hypotheses 4 to 6. In sum, the results of the correlation analyses confirm our hypotheses and lend strong support to the criterion validity of our measures of information processing.

A last analysis requires the demonstration of discriminant validity. In additional CFAs, we tested whether our information processing measures, the antecedent variables (NFC, motivation and ability), and attitude strength as an outcome variable form six distinct constructs. Figure 1 depicts the structural model that we tested with a CFA. More precisely, we tested a six-factor model against numerous alternative models. The result of this nested model comparison
demonstrates that a six-dimensional structure fits the data significantly better than all other models ($\chi^2(77) = 156.89$, $p < .001$, RMSEA = .03, 90%-CI: .02-.04, p-close = 1.00, CFI = .95, NFI = .97). Thus, the model comparison provides clear evidence for the discriminant validity of our measures.

[Insert Figure 1 about here]

In sum, the forgoing analyses have demonstrated construct validity, i.e., structural, criterion, and discriminant validity, more consistently than previous studies. For instance, construct validity was established with conventional self-report measures as well as with operative and objective measures. This enhances our confidence that our measures really assess what we had expected to measure and are distinct from related constructs.

Discussion

The third study completes our effort to provide evidence for the reliability, structural validity, and criterion validity of our scales. As an evidence of reliability and structural validity, the postulated two-factor model of information processing fits the data quite well. Additionally, our measures correlated as expected with related constructs, such as ability, motivation, NFC, and attitude strength. Compared to existing research, we found a more consistent pattern of results even for measures that did not rely on self-report data. Although some of the correlations are moderate in size, they lend strong support to the criterion validity of our measure. Finally, a nested model comparison provided convincing evidence for the discriminant validity of our measure of information processing. This brings us a bit closer to the challenging endeavor of measuring media information processing in surveys in a valid and reliable fashion.

General Discussion

Previous studies lend strong support to the notion that media information processing is an important boundary condition to media effects. Compared to laboratory research, however, the assessment of media information processing in field studies brings about a completely different set of problems. For instance, recent research has been plagued by methodological concerns pertaining to the reliability and the construct validity (i.e., structural, criterion, and discriminant validity) of measurement. Although scholars have continuously called for methodological improvement, previous research has not directly addressed these shortcomings.
This fact prompted us to refine the existing measures of media information processing strategies. Our results suggest that a two-dimensional view of media information processing is more appropriate than a one-dimensional conception. In contrast to recent research, we established structural validity by explicitly testing the expected factor structure using CFA. The postulated factor structure is confirmed in three independent studies. Additionally, the scale proposed in this paper shows sufficient reliability and construct validity. Therefore, our studies provide an important step in scale development that should encourage future studies in this domain.

Although our research offers some new and important insights into media information processing of audience members, we recognize some weaknesses. First of all, the items presented in the final version of our scales were tested only in German-speaking samples. A test in English-speaking samples must prove whether the items work similarly. However, we started our research by translating items that were originally applied in English-speaking samples. To the extent that slight reformulations in German have not changed the general meaning of items, we are confident that the items presented in the present article will perform equally well in English-speaking samples.

Another caveat refers to the construct validation demonstrated in the third study. This study provided support for construct validity based on correlations with antecedent variables and outcomes of media information processing. Admittedly, what remains unresolved here is how exactly the new measure works in a test of media effects. This caveat refers to the predictive validity as an additional subtype of construct validity. However, as the predictive value or our scales is concerned, we are convinced that the improvement in terms of psychometric properties will also enhance the explanatory power of media effects models. Given that our measurement buries less error variance, more consistent results can be expected in future media effects studies.

With a focus on methodological issues, we consider our work as a first step in an ongoing research program that aims at improving the psychometric properties of information processing scales for survey studies. As has been mentioned by most scholars, scale construction, development, and construction is an ongoing process (Cronbach & Meehl, 1955). Our study is among the first that has explicitly validated a measure of information processing. Follow-up studies should continue this process and refine the procedures of validation. As one possible avenue of research, future studies can use more rigorous procedures, such as a MTMM approach. In particular, the MTMM procedure can enhance our confidence in these
scales in terms of convergent and discriminant validity. For instance, it has to be demonstrated to what extent method variance affects the measurement of media information processing.

Implicitly, we have assumed that individuals’ abilities and motivations are antecedents and attitude strength is an outcome of media information processing. However, as with most of the previous studies, we relied on cross-sectional data. Therefore, the lack of longitudinal data makes assumptions about the causal order among variables more complicated. Although this was not the aim of our research, for a further understanding of the role of information processing in media effects, the establishment of causality is pivotal. In order to demonstrate that media information processing precedes media effects, such as learning or changes in attitudes, communication research is in need of more longitudinal studies. However, causal order can also be established in experimental settings. Although this would mean going back to the lab and consequently making concessions in terms of external validity, we expect that existing scales should perform equally well or even better in environments that allow higher control than in the field (e.g., Eveland & Dunwoody, 2002).

The distinction between heuristic and systematic media information processing has proven to be very useful in survey research on media effects. We are sure that information processing strategies remain a fertile topic in communication research. However, we also believe that additional scientific work is needed. A quite important aspect of information processing strategies that has not been addressed so far is its variability. To be more precise, we know that some people are likely to process media information systematically, while others process more heuristically. However, we know little about possible shifts from one processing mode to the other. Furthermore, we know even less about the causes or consequences of these shifts. In a panel study by Eveland et al. (2003), learning from the news media was conditional on elaborate processing. However, it was not examined whether these modes of information processing change over time.

Furthermore, the co-occurrence of both modes of information processing has been insufficiently investigated. Experimental research has demonstrated that both modes of media information processing may co-occur. For instance, the HSM postulates that “the deliberate use of more effortful strategies does not preclude the possibility that less effortful processes continue to operate. They may occur either independently or in concert with more effortful processes” (Bohner, Moskowitz, & Chaiken, 1995, p. 35). Some recent studies have investigated the co-occurrence of the two information processing modes, which can enhance, attenuate, or bias each other (Bohner, et al., 1995; see also Aune & Reynolds, 1994; but see
Booth-Butterfield et al., 1994). These studies produced conflicting results inviting additional research. Particularly, the variability and co-occurrence of heuristic and systematic information processing as well as the causes thereof over the course of time may be interesting avenues of future research.

As a whole, our studies as well as previous ones have made a big step in operationalizing and implementing measures of information processing in public opinion surveys. This research has moved measures of media information processing from the lab to the field. As a result, in numerous studies knowledge gaps, social reality judgments, or attitude change have been shown to be contingent on media information processing strategies of audience members. We have tried to make a methodological contribution to the field in order to provide a high quality measure to assess information processing strategies in surveys. So far, we hope that our work fuels future survey studies, improves existing media effects models, and enhances their predictive power.
References


Griffin, R. J., Neuwirth, K., Giese, J., & Dunwoody, S. (2002). Linking the heuristic-systematic model and depth of processing. *Communication Research, 29*, 705-732. (b, d, g, h, j)


### Appendix

**Table A1: Psychometric Properties of Existing Information Processing Scales from Selected Studies**

<table>
<thead>
<tr>
<th>Study</th>
<th>Number of factors (method of factor analysis, method of rotation)</th>
<th>Label of factors, eigenvalues (explained variance in percent)</th>
<th>Reliability</th>
<th>Inter-correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>.57 (4 Items)</td>
<td></td>
</tr>
<tr>
<td>Kahlor, Dunwoody, Griffin, Neuwirth, &amp; Giese (2003)</td>
<td>2 (EFA, oblique rotation)</td>
<td>Systematic Processing: 2.75 (30.5%), Heuristic processing: .89 (9.8%)</td>
<td>.77 (6 Items)</td>
<td>-.37</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>.63 (3 items)</td>
<td></td>
</tr>
<tr>
<td>Griffin et al. (2002; 2004)</td>
<td>2 (EFA, oblique rotation)</td>
<td>Systematic processing: 1.93 (21.4%), Heuristic processing: .43 (4.7%)</td>
<td>.69 (5 Items)</td>
<td>-.48</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>.68 (4 items)</td>
<td></td>
</tr>
<tr>
<td>Johnson (2005)</td>
<td>2 (PCA, varimax rotation)</td>
<td>Systematic processing: -- (28%), Heuristic processing: -- (28%)</td>
<td>.65 (3 Items)</td>
<td>-.35</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>.60 (3 items)</td>
<td></td>
</tr>
<tr>
<td>Trumbo (2002)</td>
<td>2 (EFA, oblique rotation)</td>
<td>Systematic processing: 3.5 (31%), Heuristic processing: 1.5 (21%)</td>
<td>.69 (4 items)</td>
<td>-.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>.43 (3 items)</td>
<td></td>
</tr>
<tr>
<td>Trumbo (1999)</td>
<td>2 (PCA, varimax rotation)</td>
<td>Systematic processing: 1.3 (--), Heuristic processing: 1.2 (explained variance of both factors 63%)</td>
<td>( r = .16 ) (2 items)</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>( r = .20 ) (2 items)</td>
<td></td>
</tr>
<tr>
<td>Researcher(s) and Year</td>
<td>Type of Analysis</td>
<td>Elaboration/Method</td>
<td>Correlation/coefficient(s)</td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------------------</td>
<td>----------------------------------------------</td>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td>Trumbo &amp; McComas (2003)</td>
<td>2 (EFA, oblique rotation)</td>
<td>Systematic processing: 1.9 (19%) Heuristic processing: 1.8 (18%)</td>
<td>.71 (5 items), .70 (5 items), .01</td>
<td></td>
</tr>
<tr>
<td>Eveland &amp; Dunwoody (2002)</td>
<td>2 (EFA, rotation method not mentioned)</td>
<td>Elaboration: -- (--), Selective scanning: -- (--), ( r = .48 ) (2 items)</td>
<td>.72 (5 items), .09</td>
<td></td>
</tr>
<tr>
<td>McLeod et al., (1999)</td>
<td>Only one factor assumed</td>
<td>Reflection</td>
<td>.66 (4 items), --</td>
<td></td>
</tr>
<tr>
<td>Eveland, Shah, &amp; Kwak (2003)</td>
<td>Only one factor assumed</td>
<td>Elaboration</td>
<td>.90 (8 items 1st panel wave), .81 (4 Items 2nd panel wave), --</td>
<td></td>
</tr>
</tbody>
</table>

Note. EFA: exploratory factor analysis; PCA: principal component analysis. Several studies did not provide any information about method of data reduction. Earlier studies by McLeod and colleagues (see Eveland, 2005; Kosicki & McLeod, 1990) are not listed because no information about these studies was available. Johnson (2005) reports correlations between factors although a varimax rotation was used in PCA that normally results in uncorrelated factors.
Table A2

*Item Wordings of Previously Used Questions to Assess Media Information Processing*

<table>
<thead>
<tr>
<th>Study Item Wordings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kahlor et al. (2006); Griffin et al. (2002; 2004)</td>
</tr>
</tbody>
</table>

**Systematic processing**

After I encounter information about this topic, I am likely to stop and think about it.

If I need to act on this matter, the more viewpoints I get, the better.

When I encounter information about this topic, I read or listen to most of it, even though I may not agree with its perspective.

After thinking about this topic, I have a broader understanding.

It is important for me to interpret information about this topic in a way that applies directly to my life.¹

**Heuristic processing**

When I see or hear information about this topic, I rarely spend much time thinking about it.

There is far more information on this topic than I personally need.

When I encounter information about this topic, I focus only on a few key points.

If I need to act on this matter, the advice of one expert is enough for me.
<table>
<thead>
<tr>
<th>Study</th>
<th>Item Wordings</th>
</tr>
</thead>
</table>
| Kahlor et al. (2003) | **Systematic processing**  
I thought about what actions I myself might take based on what I read.  
I found myself making connections between the story and what I’ve read or heard about elsewhere.  
I tried to think of the practical applications of what I read.  
I thought about what actions should be taken by policy-makers based on what I read.  
I tried to relate the ideas in the story to my own life.  

**Heuristic processing**  
I skimmed through the story.  
I didn’t spend much time thinking about the story after I read it.  
The story presented too many conflicting viewpoints. |
| Trumbo (2002); Trumbo & McComas (2003) | **Systematic processing**  
In order to be completely informed about the issue […], I feel that the more viewpoints I can get the better off I will be.  
I have made a strong effort to carefully examine the scientific information presented on the question of […].  
When the topic of […] comes up, I always try to learn more about it.  
When I encounter information about the issue of […], I am likely to stop and carefully think about it.  
This is an important issue, and it has been very important to me to decide how I feel about […].^b |
### Study Item Wordings

<table>
<thead>
<tr>
<th>Study</th>
<th>Item Wordings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trumbo (2002);</strong></td>
<td><em>Heuristic processing</em></td>
</tr>
<tr>
<td>Trumbo &amp; McComas (2003)</td>
<td>Past experiences with other situations like this have made it easier for me to decide how I feel.</td>
</tr>
<tr>
<td></td>
<td>On the issue […], I am willing to place my trust in experts.</td>
</tr>
<tr>
<td></td>
<td>I have been able to make a decision about how concerned I am about […] without seeking a great deal of additional information, by using my existing knowledge. (Trumbo &amp; McComas, (2003): I feel quite capable of finding and using the information that I need in order to decide how to feel about the issue […] by using my existing knowledge.)</td>
</tr>
<tr>
<td></td>
<td>The information I have at this time meets all of my needs for knowing about the issue […].</td>
</tr>
<tr>
<td></td>
<td>I have been able to make a decision about how concerned I am about […] using my existing knowledge.</td>
</tr>
<tr>
<td><strong>Johnson (2005)</strong></td>
<td><em>Systematic processing</em></td>
</tr>
<tr>
<td></td>
<td>I thought about what actions I myself might take based on what I read.</td>
</tr>
<tr>
<td></td>
<td>I found myself making connections between the information and what I have read or heard about elsewhere.</td>
</tr>
<tr>
<td></td>
<td>I thought about how what I had read related to other things I know.</td>
</tr>
<tr>
<td><strong>Heuristic processing</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I skimmed through the story and texts.</td>
</tr>
<tr>
<td></td>
<td>I did not spend much time thinking about the information after I read it.</td>
</tr>
<tr>
<td></td>
<td>There was far more information on this topic than I personally need.</td>
</tr>
<tr>
<td>Study</td>
<td>Item Wordings</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Trumbo (1999)         | **Systematic processing**  
 I prefer to make a judgement myself on this issue, based on scientific information with a great deal of detail.  
 To make a judgment on this issue I require statistical information.  
 **Heuristic processing**  
 I have been able to make a decision about this issue based on my previously existing knowledge and experience.  
 On this issue, I’m willing to place my trust in the experts and go with their recommendation. |
| McLeod et al. (1999)  | **Reflection**  
 After thinking or seeing a news story I think about how it relates to what I already know.  
 Often, when I’ve learned something in the news, I’ll recall it later and think about it.  
 Often, if I come across something interesting in the news, I follow it up in greater detail later.  
 Apart from discussions with other people, how often do you think about issues concerning schools? |
| Sotirovic & McLeod (2001) | **Reflective integration**  
 I often talk with my friends about stories I’ve learned about in the news to see what they think.  
 Often when I’ve learned about something in the news I’ll recall it later and think about it.  
 I rarely spend much time thinking about the news stories that I read or heard earlier.  
 I almost always try to find out additional information about a topic when I feel the news stories are incomplete. |
<table>
<thead>
<tr>
<th>Study</th>
<th>Item Wordings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eveland &amp; Dunwoody (2002)</td>
<td><strong>Elaboration</strong></td>
</tr>
<tr>
<td></td>
<td>I tried to think of the practical applications of what I read.</td>
</tr>
<tr>
<td></td>
<td>I tried to relate the ideas in the story to my own past experiences.</td>
</tr>
<tr>
<td></td>
<td>I thought about what actions should be taken by policy-makers based on what I read.</td>
</tr>
<tr>
<td></td>
<td>I found myself making connections between the story and what I've read and heard about elsewhere.</td>
</tr>
<tr>
<td></td>
<td><strong>Selective Scanning</strong></td>
</tr>
<tr>
<td></td>
<td>I only read sections of the story that looked important or interesting.</td>
</tr>
<tr>
<td></td>
<td>I skimmed through the story.</td>
</tr>
<tr>
<td>Eveland, Shah, &amp; Kwak (2003), panel study, 2 waves (w)</td>
<td><strong>Elaboration</strong></td>
</tr>
<tr>
<td></td>
<td>I often find myself thinking about what I've seen on TV news. (w1)</td>
</tr>
<tr>
<td></td>
<td>I often tie what I see on TV news to ideas I've had before. (w1)</td>
</tr>
<tr>
<td></td>
<td>I often tie what I read in the newspaper to ideas I've had before. (w1)</td>
</tr>
<tr>
<td></td>
<td>I often find myself thinking about what I've read in the newspaper. (w1)</td>
</tr>
<tr>
<td></td>
<td>I often try to relate what I see on TV news to my own personal experiences. (w1, w2)</td>
</tr>
<tr>
<td></td>
<td>I often think about how what I see on TV news relates to other things I know. (w1, w2)</td>
</tr>
<tr>
<td></td>
<td>I often try to relate what I read in the newspaper to my own personal experiences. (w1, w2)</td>
</tr>
<tr>
<td></td>
<td>I often think about how what I read in the newspaper relates to other things I know. (w1, w2)</td>
</tr>
<tr>
<td>Study</td>
<td>Item Wordings</td>
</tr>
<tr>
<td>-------</td>
<td>---------------</td>
</tr>
<tr>
<td>Eveland (2001), three studies (s)</td>
<td><strong>Elaboration</strong></td>
</tr>
<tr>
<td></td>
<td>Often when I've learned about something in the news I'll recall it later and think about it. (s1, s2, s3)</td>
</tr>
<tr>
<td></td>
<td>I rarely spend much time thinking about the stories I read or hear about in the news. (s1, s2)</td>
</tr>
<tr>
<td></td>
<td>News stories often come to have a broader meaning after I've had a chance to think about them. (s2)</td>
</tr>
<tr>
<td></td>
<td>When I come across election stories, I find myself tying the stories to ideas I've had before. (s3)</td>
</tr>
<tr>
<td></td>
<td>I often interpret election stories in a way that helps me make sense of them. (s3)</td>
</tr>
</tbody>
</table>

*Note.* a This item was used only in the study by Griffin, et al., (2002).

b This item was used only in the study by Trumbo and McComas (2003)
Table A3

Statistical Associations between Selected Processing Scales and Criterion Variables

<table>
<thead>
<tr>
<th>Criterion variables</th>
<th>Systematic processing/elaboration</th>
<th>Heuristic/selective scanning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive (Griffin et al., 2004)</td>
<td>Positive (Griffin et al., 2004; Kahlor et al., 2006; Trumbo, 1999; 2002)</td>
</tr>
<tr>
<td></td>
<td>No correlation (Eveland, 2005; Kahlor et al., 2003; 2006)</td>
<td>No correlation (Johnson, 2005; Kahlor et al., 2003; 2006)</td>
</tr>
<tr>
<td>Knowledge&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Positive (Eveland, 2005; Griffin et al., 2004; Johnson, 2005; Kahlor et al., 2006)</td>
<td>Negative (Griffin et al., 2004; Johnson, 2005; Kahlor et al., 2006)</td>
</tr>
<tr>
<td></td>
<td>No correlation (Kahlor et al., 2003; Trumbo, 1999)</td>
<td>No correlation (Kahlor et al., 2003; Trumbo, 1999)</td>
</tr>
<tr>
<td>Attitude strength&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Positive (Griffin et al., 2002)</td>
<td>Negative (Griffin et al., 2002)</td>
</tr>
</tbody>
</table>

Note. Summary is based on zero-order or partial correlations or regression weights from the cited studies.

<sup>a</sup> In the studies by Eveland (2005) knowledge is treated as the outcome of media information processing, not as an antecedent condition.

<sup>b</sup> Attitude strength was operationalized as cognitive structure strength, evaluation strength, and the number of strongly held beliefs.
### Tables

#### Table 1

*Factor loadings ( ) and item reliabilities (squared multiple correlations, SMC)*

<table>
<thead>
<tr>
<th>Media Information Processing Strategies and Item Wordings</th>
<th>Study I</th>
<th>Study II</th>
<th>Study III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SMC</td>
<td>SMC</td>
<td>SMC</td>
</tr>
<tr>
<td><strong>Systematic processing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| When I come across news about the issue, I always try to learn more about it.  
  (a)                                                      | .51     | .26      | --        |
| The more viewpoints I get, the better.  
  (b)                                                      | .69     | .48      | .76       |
| It is quite important to me to know as much as possible about that specific issue.  
  (c)                                                     | .78     | .61      | .73       | .54 | .88 | .77 |
| When I come across an article on that issue, I'm likely to read it thoroughly.  
  (d)                                                     | .75     | .56      | --        | --  | --  | --  |
| I am likely to focus on that issue in the news very attentively.  
  (e)                                                     | --      | --       | .48       | .23 | .68 | .46 |
| It is important to me to know all arguments of the discussion in detail.  
  (k)                                                     | .70     | .49      | .81       | .65 | .77 | .59 |
| **Heuristic processing**                                |         |          |           |
| I rarely spend much time thinking about the news information with respect to that issue.  
  (f)                                                     | .47     | .22      | .42       | .18 | .52 | .27 |
| I often skim through news stories on that issue.  
  (g)                                                    | .81     | .67      | .77       | .59 | .79 | .63 |
| I tune in to the news on that issue very irregularly.  
  (h)                                                    | .77     | .59      | .59       | .35 | .71 | .49 |
| Most often I glance over the media information on that issue.  
  (i)                                                    | .37     | .14      | --        | --  | --  | --  |
| I’m not interested in specific background information on that issue.  
  (j)                                                    | .60     | .36      | --        | --  | --  | --  |
| I am not that interested in details. It is sufficient to get the general idea of that issue.  
  (k)                                                    | --      | --       | .54       | .29 | .59 | .34 |
Note. The items were introduced with the following sentence: “The following statements deal with the way you engage with information in the news about the Swiss-European relationships (Study I)/Asylum law (Study II and III).” The items were answered on a five-point scale ranging from 1 for “fully disagree” to 5 for “fully agree.” The items were taken from previous studies, translated into German, and reformulated for our study. Superscripts denote the studies where the items originated (see also superscripts in the references).

º This item resulted after modification of item d after the preliminary study.

ª This item was constructed from items i and j for studies II and III.
Table 2

*Correlations among Constructs*

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Systematic processing</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) Heuristic processing</td>
<td>-.51**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) Self-reported ability</td>
<td>.57**</td>
<td>-.43**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4) Issue-specific interest</td>
<td>.74**</td>
<td>-.31**</td>
<td>.43**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5) Need for Cognition</td>
<td>.26**</td>
<td>-.25**</td>
<td>.20**</td>
<td>.15**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6) Attitude certainty</td>
<td>.22**</td>
<td>-.25**</td>
<td>.28**</td>
<td>.21**</td>
<td>.16**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7) Attitude extremity</td>
<td>.22**</td>
<td>-.17**</td>
<td>.22**</td>
<td>.28**</td>
<td>.29**</td>
<td>.28**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8) Response time</td>
<td>-.14**</td>
<td>.07*</td>
<td>.10**</td>
<td>.06</td>
<td>-.05</td>
<td>-.04</td>
<td>.05</td>
<td></td>
</tr>
</tbody>
</table>

*Note. Min N = 885 due to missing values; * p < .05, **p < .01*
Figure Captions

*Figure 1. Final Structural Model to Establish Discriminant Validity.*

Note. For single item measures (ability and attitude strength) error variances are set to zero to achieve identifiability. The three measures of attitude strength (attitude extremity, attitude certainty, and response latency) do not form a single factor. Therefore, tests for discriminant validity are run for single-item measures of attitude strength.