

Measuring the Impact of the E-Mail Conversation Format on E-Mail Overload: A Pilot Test

Full Paper

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Abstract

It is well known that e-mails are causing information overload. Existing research investigated the amount of e-mails but does not consider the format of a single e-mail and its cognitive impact. Therefore, we investigate e-mail conversations as one of the most promising formats, which is composed of the quoted history of appended e-mails, forwarded to a third person. Cognitive load theory is used to scrutinize the contribution of the e-mail conversation format on intrinsic, extraneous, and germane cognitive load. The resulting hypotheses and our pilot of the experiment investigate the induction of e-mail overload by e-mail conversations. By successfully validating our measurement instruments we gain first indications of construct validity. As a result we present an exploratory factor analysis, a confirmatory factor analysis, and an assessment of the model fit. Subsequently, we reflect on our findings and present the implications for future research.

Keywords

E-mail overload, information overload, cognitive load, e-mail conversations, pilot test.

Introduction

White collar workers are experiencing stress through the introduction of new technologies (Ragu-Nathan et al. 2008), but also through the use of established technologies like electronic mails (e-mail) (Barley et al. 2011). Stress is a major contributor to the phenomenon of information overload (IO) (Moore 2000). Researchers (e.g., Gill 1998; Schroder et al. 1967) characterized IO by an “excessive supply” (Savolainen 2007, p. 614) of information as the principal point of the ambiguous and omnipresent IO phenomenon (Eppler and Mengis 2004). The phenomenon has been researched in various contexts like online interaction spaces (Jones et al. 2004) or social network sites (Maier et al. 2014) but also for established technologies like e-mail (Dabbish and Kraut 2006; Sumecki et al. 2011). Many of these insights are built on the amount of information as the principal point of the IO phenomenon, for example by investigating the volume of social information (Maier et al. 2014) or the amount of postings (Jones et al. 2004). For the technology e-mail, existing research investigates the amount of e-mails sent and received, as well as the time spent on these activities (e.g., Dabbish and Kraut 2006; Sumecki et al. 2011). The term e-mail overload describes the phenomenon of IO, caused by the amount of e-mails (Sumecki et al. 2011) and we will use this term in the remainder of the paper.

Scholars looked at IO and the e-mail overload phenomenon by investigating the total amount of e-mails and the individuals’ perceptions about these. This research focus neglects the format of e-mails and does not open the black box of how e-mail overload emerges. It is known that e-mail is used not only for communication, but also for different types of tasks which leads to different types of e-mail formats (Whittaker and Sidner 1996). Existing research does not consider how these different formats are perceived by individuals. We contribute to the understanding of e-mail overload by investigating the impact of the e-mail format on e-mail overload by extending established research. Our central argument is that the root cause of the problem is the format of an e-mail, not only the high volume of e-mails that overloads white collar workers. Hence, we investigate e-mail conversations, how we call quoted histories

of e-mails sent back and forth between participants, appending the past e-mails and answering on top. We look at the entire conversation by processing all quotes when the e-mail conversation is forwarded to a new communication participant, not at the emergence of e-mail conversations. We have chosen this format as the forwarding of e-mails is stimulated by the increased division of labor and the needed information exchange and e-mails sent around in organizations are a major predictor of IO (Schultz and Vandenbosch 1998).

This paper aims to present an important step to open the black box of the e-mail overload phenomenon and investigate the format of a single e-mail. We suggest drawing on cognitive load theory (Sweller 2010; Sweller et al. 2011; Sweller et al. 1998; Van Merriënboer and Sweller 2005; Van Merriënboer and Sweller 2010) to measure intrinsic, extraneous, and germane cognitive load of e-mail conversations. By drawing on insights of cognitive science, intrinsic cognitive load is imposed by the content of an e-mail, extraneous cognitive load is imposed by an inadequate presentation format, and germane cognitive load by the learning activities to cope with this format (Sweller et al. 2011). Consequently, we ask the following research question: “*What is the impact of e-mail conversations on intrinsic, extraneous, and germane cognitive load?*”

We designed an experiment providing the same content to one group in the format of a single e-mail and to one group in the format of an e-mail conversation. We carried out a pilot study, conducted a confirmatory factor analysis, and assessed the model fit based on an experiment with 29 participants in order to gain first indications on construct validity.

Consequently, we present the results of the pilot study aiming to measure the impact on intrinsic, extraneous, and germane cognitive load by the format of e-mail conversations. Due to the small sample size and the new items, we only investigate the measurement model and not the hypothesis. So, this paper is an important building block towards answering our research question by providing validated measurement instruments. No data is provided to test our hypotheses because the aim of this paper is to develop a valid measurement model for further research.

The remainder of the paper is structured as follows. First, we discuss e-mail overload and its causes as related work. Cognitive load theory and the hypotheses development are presented in Section 3. In Section 4 we describe the used method in terms of our experiment and the developed measurement scales. Section 5 presents the results of the pilot and in the second to last section we discuss our findings and give a summary in the last section.

Related Research

There are two different research streams investigating the phenomenon of e-mail overload (Grevet et al. 2014): Scholars investigate the high volume of e-mails that are stored in the inbox but they are also looking at the high amount of incoming e-mails and an individual’s perception of this. The first stream realized early that there are many e-mails stored in the inbox and that e-mail is also used for other tasks (e.g., task management) than communication (Whittaker and Sidner 1996). Computer science developed solutions trying to mitigate the problem by classifying e-mails, automatically sorting them into folders, and auto archiving (e.g., Bälter and Sidner 2002; Schuff et al. 2006). Some of these features have been implemented in state-of-the-art e-mail software (Sumecki et al. 2011). Despite these software solutions, current studies confirm the presence of the phenomenon in contemporary mailboxes until today (Fisher et al. 2006; Grevet et al. 2014; Szóstek 2011).

Based on the research stream of IO a second meaning of e-mail overload emerged which is concerned with the high volume of incoming e-mails and a human’s perceptions of it (Dabbish and Kraut 2006; Sumecki et al. 2011). Also this phenomenon is still problematic and present up to this day (Grevet et al. 2014). We make use of this meaning in our paper because it involves human’s perceptions and it is more appropriate to answer our research question which is based on the investigation of cognitive load. Insights of IO are often based on the “excessive supply” (Savolainen 2007, p. 614) of information so that individuals are unable to cope with it (e.g., Gill 1998; Sumecki et al. 2011). One of the major antecedents is the increased computer-mediated communication in organizations (Hiltz and Turoff 1985). Especially e-mails which are still used quite intensively in organizations (Grevet et al. 2014), increased the amount of information that is available to and shared between participants (Bawden 2001). Scholars (e.g., Dabbish and Kraut 2006; Ducheneaut and Bellotti 2001; Ingham 2003; Sumecki et al. 2011) coined the term e-mail overload as the

state where the use of e-mail is overwhelming the user (Sumecki et al. 2011) due to individual's limited cognitive capacity (Berghel 1997; Heylighen 2004; Kirsh 2000). E-mail overload studies investigate how individuals perceive the volume of e-mails that are sent around and the time needed (Sumecki et al. 2011). Furthermore, different aspects have been added to first research insights regarding the high amount of incoming e-mails (Dabbish and Kraut 2006). Interruptions caused by incoming e-mails and how often e-mails should be retrieved are additional investigated insights (Gupta et al. 2013; Gupta et al. 2011; Renaud et al. 2006; Vidgen et al. 2011). To sum up, existing research concentrates on the total amount of antecedents and its impact on the overall perception of being overloaded. To our knowledge none of the existing research investigates the impact of the format of e-mails on cognitive load or the contribution to e-mail overload.

Theoretical Background and Hypotheses Development

Early works identified the relation between the use of information technology leading to cognitive overload (Vollmann 1991). Communication that is conducted through an electronic channel increases ambiguity and cognitive load in comparison to natural face-to-face communication (Kock 2004; Kock 2005; Kock 2009). In order to compensate for missing cues in unnatural electronic communication more cognitive load is necessary (Kock 2001a; Kock 2001b; Kock 2007). Thus, we scrutinize a cognitive lens to investigate how the format of e-mail conversations impacts e-mail overload by assessing intrinsic, extraneous, and germane cognitive load during the decoding of e-mail conversations.

Cognitive load theory (Sweller 2010; Sweller et al. 2011; Sweller et al. 1998; Van Merriënboer and Sweller 2005; Van Merriënboer and Sweller 2010) is used to explain the limitations of individuals processing capacity (Berghel 1997; Heylighen 2004; Kirsh 2000). Researchers make use of the human cognitive architecture in cognitive load theory and the argument that working memory is limited. The theory differentiates between working memory and long-term memory. Working memory is limited to five to nine pieces of information (Miller 1956) or merely four when working with it (Cowan 2001). It can be equated with consciousness (Sweller et al. 1998). Working memory aims to relate new information to existing information and acquire new schemas (Sweller 2010; Sweller et al. 2011). Long-term memory is virtually unlimited in the storage of schemas (Chi et al. 1982). Retrieving schemas is an unconscious automation in the long-term memory and does not involve working memory (Schneider and Shiffrin 1977; Shiffrin and Schneider 1977). Existing literature distinguishes cognitive load occurring in working memory by its causes into three different types (Sweller et al. 2011): (1) intrinsic, (2) extraneous, and (3) germane cognitive load which are described in Table 1.

Type of cognitive load	Description
Intrinsic	The information itself causes intrinsic cognitive load.
Extraneous	Inadequate presentation of the information causes extraneous cognitive load.
Germane	Learning activities in terms of schema acquisition causes germane cognitive load.

Table 1. Cognitive Load Types

Drawing on cognitive load theory, working memory is seen as the restriction leading to the limitation of human information processing capacity (Chen et al. 2011; Chen et al. 2012). Consequently, we also see the shortage of working memory as the cause for e-mail overload and upon this; we develop our hypotheses to investigate how the format of e-mail conversations is impacting intrinsic, extraneous, and germane cognitive load.

Intrinsic cognitive load (Sweller 2010; Sweller et al. 2011; Sweller et al. 1998) is caused by the information itself (Sweller et al. 2011; Sweller and Chandler 1994). The information is segmented into information elements that are related and interact with each other (Sweller and Chandler 1994). Existing studies see a strong relation between the amount of interactive information elements and the induced cognitive load (e.g., Barrouillet et al. 2007). For our e-mail context, information elements are embedded in the content of the e-mails. The more difficult the content is and the more information is embedded in

the e-mail, the higher the induced intrinsic cognitive load. In our study we investigate the format of e-mail conversations and do not change the content of the e-mail conversations. As the content is the same and the embedded information elements are also the same, we propose that the intrinsic cognitive load does not change and therefore stands as a manipulation check: Readers of e-mails in the e-mail conversation format experience the same intrinsic cognitive load as those of the same e-mail in a single e-mail format.

Extraneous cognitive load (Sweller 2010; Sweller et al. 2011; Sweller et al. 1998) is caused by inadequate presentation of information, regardless of the embedded information. It has been investigated that lower levels of extraneous load facilitate understanding because an adequate presentation format is used (Sweller and Chandler 1994; Sweller et al. 1990). Research identified several extraneous cognitive load increasing effects. Especially the *split attention effect* increases extraneous cognitive load by choosing a presentation format which requires mental integration of information. Mental integration is needed when a physically separated presentation format is chosen such as text and diagrams (Chandler and Sweller 1992) or computers and manuals (Sweller and Chandler 1994). Those additional interactive elements forces working memory into mental search and integration rather than concentrating on the information (Chandler and Sweller 1991; Chandler and Sweller 1992; Sweller et al. 1990; Tarmizi and Sweller 1988; Ward and Sweller 1990). For our e-mail context, we investigate e-mail conversations which are quoting and appending the conversation history to the end of an e-mail. The content of the e-mail is split and distributed over the whole conversation history into several quotes. This format results in a physically not integrated presentation format that is supposed to lead to a split attention effect. As existing research also observed a split attention effect between nonintegrated blocks of texts (Chandler and Sweller 1992), we propose to readers that are reading the whole e-mail conversation also an split attention effect, as part of the working memory will be engaged into mental search and integration which will induce extraneous cognitive load:

Hypothesis 1: Readers of e-mails in the e-mail conversation format experience a higher extraneous cognitive load than those who read the same e-mail in the single e-mail format.

Germane cognitive load is induced by learning activities in terms of schema acquisition and is important for learning (Kalyuga 2011; Sweller 2010). Schema acquisition is the process of relating new information to existing information in long-term memory (Chi et al. 1982). As working memory is first used for intrinsic and extraneous cognitive load, germane cognitive load and learning only takes place if enough cognitive capacity is still available (Sweller et al. 1998; Van Merriënboer and Sweller 2005; Van Merriënboer and Sweller 2010). For our e-mail context, we expose the readers of e-mail conversations to the format of e-mail conversations. Thus, they are able to learn how to cope with this format. As the readers of a single e-mail do not see the format of e-mail conversations, they do not need to use the format and are also unable to create schemas how to effectively decode information embedded in e-mail conversations. We posit the following hypothesis:

Hypothesis 2: Readers of e-mails in the e-mail conversation format experience a higher germane cognitive load than those who read the same e-mail in the single e-mail format.

To test our hypotheses we developed context specific constructs of cognitive load to reflect the research domain. These constructs now refer to e-mails and are presented in Table 2.

Construct	Description
Intrinsic cognitive load (e-mail)	The information in terms of the content of the e-mail text causes intrinsic cognitive load.
Extraneous cognitive load (e-mail)	Inadequate presentation of the e-mail in terms of an inadequate presentation format of an e-mail causes extraneous cognitive.
Germane cognitive load (e-mail)	Learning activities in terms of schema acquisition in terms of how to cope with an inadequate presentation format of e-mail conversations causes germane cognitive load.

Table 2. E-Mail Constructs and their Descriptions

Research Method

We designed an anonymous experiment to test our hypotheses in which we exposed participants to e-mails covering the same content. We manipulated the e-mail format and either presented the e-mail as a single e-mail or split it into the format of e-mail conversations (please see Figure 1 for snippets of an example and Figure 2 for details on the manipulation).

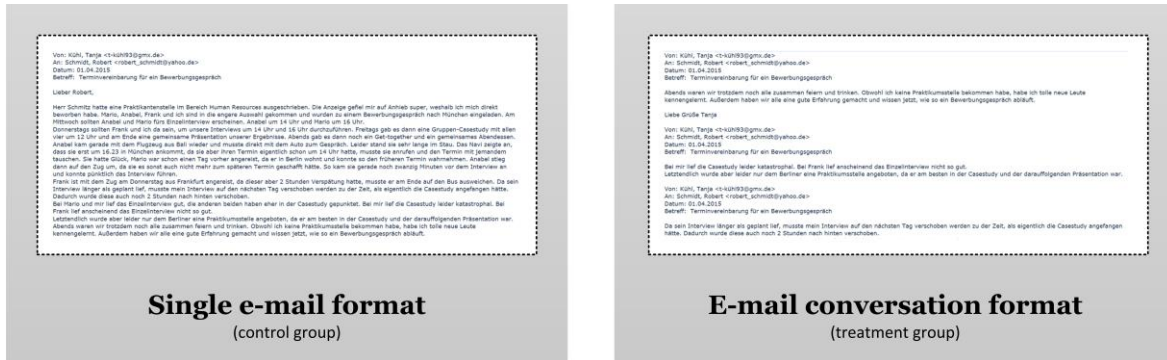


Figure 1. Experiment Manipulation

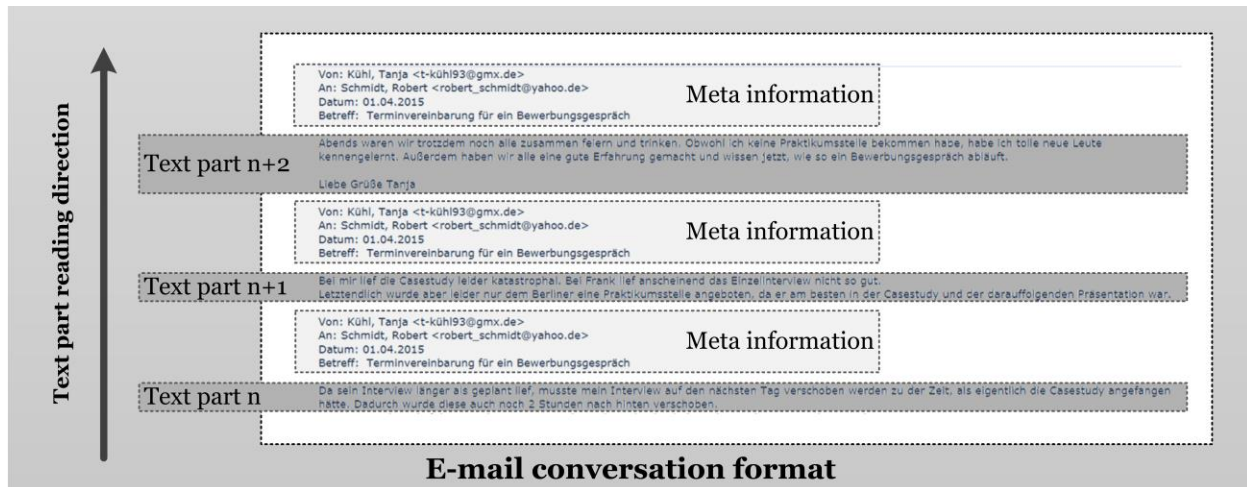


Figure 2. Manipulation Details

During the reading of the e-mail we asked the participants to answer questions based on the provided e-mail using a multiple choice test afterwards. Subsequently the participant’s intrinsic, extraneous, and germane cognitive load was assessed with the measurement scales in the next section. As a last step control variables were collected. A lottery of Amazon vouchers among the best participants was used to incentivize correct answers. A detailed illustration of the experiment procedure is outlined in Figure 3.

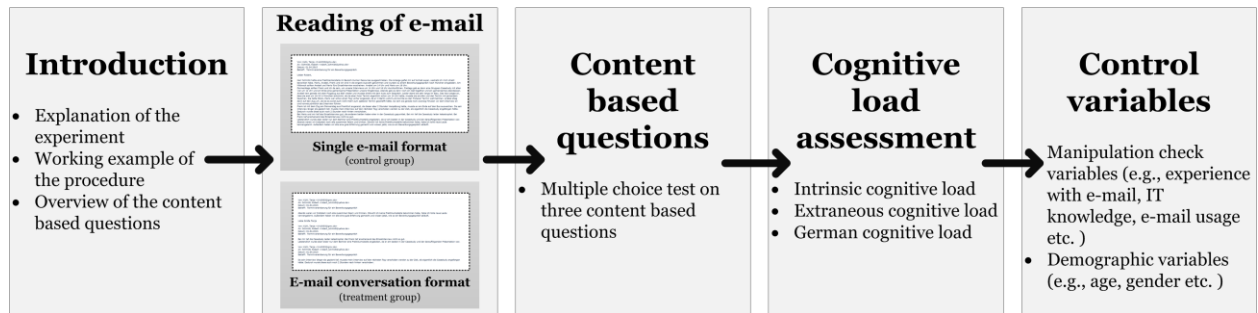


Figure 3. Experiment Procedure

Before testing our experiment in a larger scale we conducted a pilot test with the software LimeSurvey¹ for assessing our measurement model and get first indications of construct validity and reliability. 29 students and professionals were recruited online. To avoid priming effects of the terms e-mail and e-mail overload, participants were invited to a study on answering content based questions about a text. Our sample was composed of 17 male and 12 female participants who were either native speakers or fluent in the language of the experiment. The average age of the participants was 26.93 (SD = 8.09; range = 19 - 54) and 93.10% of them check their e-mails five or more times per day. As we evaluated the measurement model together for both groups and did not seek support for our hypotheses by group comparisons (t-test), we omitted checks whether the two experimental groups originate from the same population.

Measurement

To obtain the items for our experiment, we conducted a content validity assessment (Moore and Benbasat 1991; O'Leary-Kelly and Vokurka 1998). All items were redeveloped based on a psychometric instrument which is able to distinguish between intrinsic, extraneous, and germane cognitive load in the learning context (Leppink et al. 2014). Subjective rating scales for mental effort (e.g., nine-point unidimensional scale, Paas 1992) are used quite often in existing cognitive research (see Paas et al. 2003; Van Gog and Kester 2012 for an extensive discussion). The scales were adapted for our domain and purpose. Thus, the reference unit of the items was changed to the content of the text for intrinsic cognitive load and the format in terms of the structural outline for extraneous and germane cognitive load. We developed new items to improve content validity and to overcome issues of internal consistency with the existing items. All items refer to the text the participants were exposed to. The final items are presented in Table 3.

Construct	Item	
E-mail intrinsic cognitive load	ICL1	The storyline covered in this text was complex.
	ICL2	The content of this text was hard to understand.
	ICL3	I had difficulties to keep up with the text's content.
E-mail extraneous cognitive load	ECL1	The text's structural outline (not content-related) was confusing.
	ECL2	I invested a high mental effort in the text's inefficient structural outline (not content-related).
	ECL3	The text's structural outline (not content-related) was burdensome to me.
E-mail germane cognitive load	GCL1	Reading the text enhanced my understanding of its structural outline (not content-related).
	GCL2	Reading the text helped me to deal with texts with a similar

¹ <http://www.limesurvey.org/>

		structural outline (not content-related).
	GCL3	Reading this text enhanced my knowledge regarding this type of structural outline (not content related).

Table 3. Measurement Scales

Results

Based on our pilot test we assessed the validity of our measurement model by conducting first an exploratory factor analysis (EFA) and afterwards a confirmatory factor analysis (CFA) using IBM SPSS 20 and IBM SPSS Amos 16. The EFA was performed with varimax rotation and the number of factors was identified by an eigenvalue cutoff of 1.00. Items that were not loading strongly on its intended factor or too strong on other factors were excluded from the analysis. In general all items performed as intended and therefore and due to space restrictions we present only the results of the CFA.

With the result of the EFA we performed a CFA assessing our measurement model. The reliability and convergent validity are shown in Table 4. By using established guidelines (Gefen et al. 2011; Hair et al. 2011; Straub et al. 2004) Cronbach's Alpha and Composite Reliability are suggested to be larger than 0.7 and the Average Variance Extracted (AVE) should be at least 0.5. Our constructs exceed all three thresholds which is a good indicator for reliability and convergent validity. For discriminant validity please consult also Table 4, where we present the latent variable correlations and the Fornell-Larcker Criterion. The correlations to the constructs need to be lower than the square root of the AVE.

Construct	Cronbach's Alpha (>0.7)	Composite Reliability (>0.7)	AVE (≥ 0.5)	Mean	S.D.	ICL	ECL	GCL
E-mail intrinsic cognitive load (ICL)	0.88	0.87	0.69	4.41	2.81	0.83		
E-mail extraneous cognitive load (ECL)	0.89	0.92	0.80	4.78	3.11	0.51	0.89	
E-mail germane cognitive load (GCL)	0.93	0.93	0.82	3.17	2.74	-0.06	0.36	0.91

Note: AVE = Average Variance Extracted, S.D. = Standard Deviation. Diagonal elements of the last three columns represent the square root of the AVE. Off diagonal elements are the correlations among latent constructs.

Table 4. Evaluation of Reliability and Convergent Validity

The loadings and cross-loadings of the items on the constructs are presented in Table 5. All the requirements of established guidelines are fulfilled, meaning all items load higher than 0.7 on the intended construct (Hair et al. 2011) and substantially less on other constructs (Straub et al. 2004).

Construct	Item	ICL	ECL	GCL
E-mail intrinsic cognitive load (ICL)	ICL1	0.799	0.410	-0.051
	ICL2	0.741	0.380	-0.047
	ICL3	0.940	0.482	-0.059
E-mail extraneous cognitive load (ECL)	ECL1	0.427	0.833	0.301
	ECL2	0.477	0.930	0.336

	ECL3	0.467	0.912	0.329
E-mail germane cognitive load (GCL)	GCL1	-0.056	0.321	0.889
	GCL2	-0.058	0.329	0.911
	GCL3	-0.058	0.332	0.919

Table 5. Loadings and Cross-Loadings

To evaluate the model fit we calculated established fit indices (Browne and Cudeck 1993; Gefen et al. 2011; Hair et al. 2010; Hu and Bentler 1999). All values and the respective suggested values are presented in Table 6. Nearly all fit indices exceed the recommended thresholds, except AGFI, GFI, and NFI. These low values may be caused by our low sample size, as AGFI and GFI tend to improve with larger samples (Bollen 1990; Shevlin and Miles 1998). Also NFI underestimates samples with less than 200 participants (Bentler 1990; Mulaik et al. 1989). As per recommendation (Kline 2005) we see all model fit indices in combination which are indicating a good model fit.

Fit Index	Suggested Value	Value
χ^2 (df, p)	Lower is better	24.884 (23, 0.356)
χ^2 /df	<3	1.082
RMSEA	<0.080	0.054
SRMR	<0.090	0.065
AGFI	>0.850	0.697
GFI	>0.900	0.845
NFI	>0.900	0.876
TLI	>0.950	0.982
CFI / RNI	>0.950	0.989

Table 6. Fit Indices

Discussion

The aim of this paper is to investigate how the format of e-mail conversations is impacting intrinsic, extraneous, and germane cognitive load. We looked at e-mail conversations, as if a third person is involved and reading the history of quoted e-mails between two or more communication participants. The format of e-mail conversations is investigated as existing insights are built solely on the total amount of e-mails and different types of e-mails in terms of formats are not considered. For our hypotheses, we draw on cognitive load theory (Sweller 2010; Sweller et al. 2011; Sweller et al. 1998; Van Merriënboer and Sweller 2005; Van Merriënboer and Sweller 2010) and make use of psychometric measurement scales to differentiate between intrinsic, extraneous, and germane cognitive load (Leppink et al. 2013; Leppink et al. 2014). E-mail conversations are split through its meta information (e.g., date and time of the e-mail) which leads to physical distribution. For that purpose, the split attention effect is used to explain the impact of the format of e-mail conversations on extraneous cognitive load, because physically not integrated presentation formats induce additional extraneous cognitive load by the needed mental integration.

To answer our research question we developed an experiment in which we exposed participants to the same e-mail either in the format of a single e-mail or split into the format of an e-mail conversation. Based on the provided e-mails participants were asked to answers content based questions. Subsequently

the participant's intrinsic, extraneous, and germane cognitive load was assessed. Based on a pilot test among professionals and students an exploratory factor analysis and a confirmatory factor analysis indicated that we have strong reliability, discriminant validity, and convergent validity for all of our three constructs. Also our fit indices indicate a good model fit. In consequence, we built a strong measurement basis and piloted an experiment. This is a crucial step towards identifying how the format of e-mail conversations is impacting intrinsic, extraneous, and germane cognitive load.

The main contribution of this paper is the analysis of the measurement scales, based on the pilot of the experiment. We contribute towards e-mail overload by operationalizing the measurement of e-mail induced IO, what we call e-mail overload. Existing research considers the limitations of humans working memory only implicit (Dabbish and Kraut 2006; Sumecki et al. 2011). By measuring intrinsic, extraneous, and germane cognitive load we overcome these limitations as working memory utilization is assessed. By assessing e-mail formats with intrinsic, extraneous, and germane cognitive load we do not only open the black box of e-mail overload but we also show that it is possible to distinguish further antecedents of e-mail overload by isolating them and assessing its impact on intrinsic, extraneous, and germane cognitive load. It is well known that working memory capacity differs between individuals (Feldman Barrett et al. 2004; Just and Carpenter 1992). Existing research does not account for this fact and gives an overall perception (e.g., Barley et al. 2011). Because cognitive load is not dependent on working memory capacity (Sweller et al. 2011), these limitations does not apply for our research design. Even though existing research is not assessing cognitive load in their investigations of e-mail overload (e.g., Adam 2002; Girrier 2003; Ingham 2003; Whittaker and Sidner 1996) we are also able to distinguish between intrinsic, extraneous, and germane cognitive load. Distinguishing between different types of cognitive load is beneficial as they result from different causes. Whereas intrinsic cognitive load cannot be changed, extraneous cognitive load is caused by inadequate presentation and can be reduced without changing the content of the e-mail. Germane cognitive load which is dealing with learning activities can be also reduced if there is less inadequate presentation. Overall partially germane and especially extraneous cognitive load are the theoretical base for coping tools, coping strategies and optimization in general, as they should aim for the reduction of those load types. Additionally we contribute to the causes of e-mail overload by being able to investigate the format of e-mail conversations. This approach is congruent with the investigation of existing single causes, such as interruptions (Gupta et al. 2013; Gupta et al. 2011; Renaud et al. 2006; Vidgen et al. 2011).

We also contribute to the more general research stream of IO with this paper by providing a valid measurement instrument to assess intrinsic, extraneous, and germane cognitive load of not only the format of e-mail conversations but also of any text format. A related concept of cognitive load has been used in the early stages of IO research (Grisé and Gallupe 1999). However, to our knowledge cognitive load, especially intrinsic, extraneous, and germane cognitive load has not been used to assess causes of IO. With this approach of assessing causes we provide the possibility to extend existing insights on information characteristics (Keller and Staelin 1987; Plumlee 2003; Schneider 1987) and gain a deeper understanding how and by which cognitive load these information characteristics contribute to IO.

Our measurement model, the design, and the pilot of our experiment are also an important contribution for practice. For white collar workers it is first priority to understand how they can reduce e-mail overload by knowing how much specific causes contribute to e-mail overload. Our work can be used as a toolbox for analyzing whether coping tools or coping strategies are able to help them to reduce the probability of e-mail overload. Based on the concepts of intrinsic, extraneous, and germane cognitive load they are able to evaluate whether coping tools or coping strategies indeed result in a reduction of cognitive load. The reduction of cognitive load is either based on the real reduction of information which results in a lower intrinsic cognitive load or if it is based on extraneous cognitive load which is based on an adequate presentation. For practitioners it is suggested to improve the presentation of information and reduce extraneous cognitive load as no information is lost. More specific for the format of e-mail conversations it is advisable to avoid the reading of long e-mail conversations as an overhead of extraneous and germane cognitive load is created by the presence of a split attention effect. Practices like the forwarding of e-mail conversations in order to involve third persons can be improved by summarizing the key facts.

For future research, we encourage researchers to use our hypotheses or our measurement scales in order to develop experiments assessing intrinsic, extraneous, and germane cognitive load of different types of texts. We will sharpen and adapt our items and will seek support for our hypotheses with an experiment. Furthermore, it is promising to explore additional formats of e-mails as existing research shows that e-

mail is not only used for communication but also for other tasks (Whittaker and Sidner 1996). In a second step the impact of these e-mail formats on intrinsic, extraneous, and germane cognitive load can be assessed using our validated scales.

Our study is not without limitations. The format of e-mail conversations is not the single cause of IO as existing research also sees the high amount of e-mails sent around as a cause of stress (Barley et al. 2011) and IO (Dabbish and Kraut 2006; Sumecki et al. 2011). But other technologies are also able to cause IO (Bawden 2001) and even without any technology, information is able to cause IO (Schroder et al. 1967). Looking at the methodology, we obtained good results for our measurement model, fit indices, validities, and reliability. In terms of the measurement of cognitive load we focused on latent variables which are in this case able to differentiate intrinsic, extraneous, and germane cognitive load. However, further assessment methods for cognitive load in general are available (e.g., electroencephalography Antonenko et al. 2010). Due to the limited data in the pilot study, we did not seek support for our hypotheses and therefore we are unable to fully answer our research question.

Conclusion

Because existing research relies on the total amount of e-mails and individual's perception about it we demonstrated that also a single e-mail in terms of the format needs to be examined. We investigated the format of e-mail conversations, which is characterized by answering on top of the history of quoted e-mails. By drawing on cognitive load theory we designed an experiment to measure intrinsic, extraneous, and germane cognitive load and conducted a pilot test which we analyzed based on exploratory factor analysis, confirmatory factor analysis and model fit. The results indicate strong reliability, discriminant validity, and convergent validity, as well as good model fit. With this unique measurement model, based the pilot of our experiment, we contribute to e-mail overload and IO.

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