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Putting some order in person memory: Memory for (serial) order in impression formation

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To my princess and my parents

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Abstract

The present work examines the representation and retrieval of order information in person memory. The study of memory for serial order has been absent from the research on the underling memory processes of impression formation, which has been focusing exclusively on item information. In this work we argue that our understanding of person memory is incomplete without an account for order and item information representation and retrieval. According to a chaining hypothesis, we predicted that the organizational processes involved in impression formation would hinder the ability to represent order by means of associations between items in successive positions. The first three experiments indicated, contradicting our hypothesis, that when people form impressions they are able to represent, retrieve and use order information for order judgements and (serial) recall. The two following studies, experiment 4 and 5, directly manipulated the associations that were built in memory when people formed impressions, to understand whether order information representation was based on associations between items that appeared in successive serial positions. Results showed that the ability to use order information was unaffected by changes in the structure of non-serial inter-item associations, which suggests that order representation is not derived from mere serial associations. Experiment 6, the last from the set of experiments reported here, suggested that the representation of order information is less dependent on episodic memory, in contrast to item information. The findings from this set of 6 experiments suggested, firstly, that when people form impressions they are able to reconstruct serial order (even when such order has no meaning), and secondly, that order representation in person memory seem not to be derived from the inter-item associations formed at encoding. Finally, an ordinal proposal for the representation and use of order in person memory is discussed.

Resumo

O objectivo central do presente trabalho é o estudo da representação e recuperação da informação de ordem em memória de pessoas. A memória de ordem serial tem permanecido fora da investigação sobre os processos mnésicos subjacentes à formação de impressões, investigação esta que se tem centrado exclusivamente na informação de item. Argumentamos que o conhecimento sobre memória de pessoas não pode ser completo sem que haja uma compreensão dos processos envolvidos na representação e recuperação da informação de ordem. De acordo com a hipótese de chaining, os processos que caracterizam a formação de impressões prejudicam o estabelecimento de associações entre itens em posições sucessivas, interferindo com a representação da informação de ordem. As três primeiras experiências sugerem, contrariamente ao esperado, que quando as pessoas formam impressões estão a representar informação de ordem, que pode ser utilizada em tarefas de julgamento e recordação. Nas experiências 4 e 5 manipulámos directamente as associações que se formam durante a codificação, quando as pessoas formam impressões, tentando perceber se a representação de ordem se basearia em associações entre itens em posições seriais sucessivas. Os resultados indicam que, independentemente da mudança na densidade associativa da rede, a capacidade de os participantes acederem e utilizarem informação de ordem não é afectada. Estes dados sugerem que a representação da informação não acontece pela mera associação de itens em posições sucessivas. A experiência 6 sugere que a representação da informação de ordem, em contraste com a informação de item, depende menos da memória episódica. Este conjunto de resultados sugere (i) que quando as pessoas formam impressões são capazes de reconstruir a ordem e (ii) que a representação da informação de ordem em memória de pessoas não é dependente das associações que se estabelecem entre os itens, durante a codificação. Finalmente, uma proposta ordinal para a representação e recuperação da ordem em memória de pessoas é discutida.

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INTRODUCTION

0. Overview of the Introductory Section

"*The importance of the order of impressions of a person in daily experience is a matter of general observation and is perhaps related to the process under investigation. It may be the basis for the importance attached to first impressions. It is a matter of general experience that we may have a "wrong slant" on a person, because certain characteristics first observed are given a central position when they were actually subsidiary, or* vice versa."

Solomon Asch, 1946, p.273 Experiment VII

Today is a typical day. As usual, you get up and it is still dark outside. Across the street, the park quietly awakes. You get your running gear and head out for your daily run into the darkness, before the first light arrives. Brr, it is cold today. As soon as you leave the door you can see your breath. You start running right away. Today you decide to go right, running anti-clockwise in the greenbelt park. No, you are not alone in your early morning incursions into the darkness. There are a few others that, like you, go out before the sunrise. Actually, it is not uncommon that you run by a few people during your daily runs. Mostly, people walking their energetic, happy and smiley dogs. Since you have been doing this daily routine for the past couple of months, you already know pretty much everyone. Actually, it is not easy to balance your cardiopulmonary rhythm with too many "hi"s. But you have been doing this for quite a long time, so you are trained and able to manage it. Today, however, you spotted someone new. Apart from you, there is someone else running. Wow, you are not alone in you early morning running craziness. This person, like you, is running anti-clockwise. So, you decide to keep a distance of about one hundred meters (approximately 110 yards) and there you go, observing this new person. You cannot see much, it is dark and you can only see that there is a person running in front of you. But immediately your mind starts wondering, how this person should be. At that moment, you see that this person briefly stops running to help an old lady that slipped on the grass and fell. Then, the person continues, reaches for their ipod from the pocket and, a few meters afterwards, kicks a sleepy squirrel that was passing by. Shortly after the person turns right, exits the park and your time span of observation is now over. During the remainder of your run you wonder about what your new running buddy is like. You only saw that this person helped an old lady and kicked a squirrel. For some reason you have the feeling that this is a friendly person. You get yourself thinking that apart from being an early runner, this person decided to help the old lady. The squirrel episode must have been, for sure, just a mishap, you guess.

A few hours later, at lunch, you are introduced to a new colleague that has recently moved to your department. Since your colleagues know you run every morning, you are introduced as a running geek. Apparently this guy that you are meeting also loves to run. Your first comment is “Really? Interesting!”, followed by “Where in town have you been running?”. To your surprise, the guy tells you that not only he has been running in the same park as you but, moreover, he likes to run a dawn. Ok, you realize that this is the person you saw in the morning and immediately your impression of friendliness pops-up. Well, actually you do not know much. Only that the guy was friendly enough to help the old lady, but unfriendly enough to kick the sleepy squirrel. However, for some reason you noticed that you have a positively glazed impression of the guy and you wonder why. Is it because he runs? Is it because he does so in the mornings? Sure, but it cannot be just that. Is it because he helped an old lady? Maybe. But wait, he also kicked a sleepy squirrel.

Ok, you decided to briefly imagine what would have been your impression if, before anything else, the guy had kicked the sleepy squirrel? Even if afterwards he had helped the lady, and you realize that the negativity of that kick would have stuck to the impression he left – no way could he be a good person! Well, you realize that fortunately you first saw the guy helping the lady, otherwise you would have to somehow, “accidentally”, spill your iced coffee over his back!

The introduction of the present thesis is divided in three chapters: (1) *Cognitive Representation of People and Person Memory*; (2) *Serial Position Effects and Order Effects in Social Psychology*; and (3) *Memory for Serial Order in Human Memory.* The overarching goal of such introduction is to lead an informed and contextualized reader through a series of literatures and research findings to reach the conclusion that person memory – an area of knowledge about the way we represent and access information describing persons in memory – although extremely well developed from the theoretical and modeling perspective, is dramatically incomplete without a proper account for order information, a pervasive type of information in the world. The representation of order information in the memory structures we develop about persons must account for order, otherwise, you would not find yourself thinking about spilling your drink over the guy's back if he had behaved in the reverse order.

To do so, we propose to take the reader from the contribution of the inception of the social cognitive level of analysis in the study of impression formation, to the way the knowledge about persons is represented in memory. We will emphasize the modeling efforts that were developed to understand impressions and to account for the impressive array of findings produced by this literature, namely the incongruency effect.

After detailing what is the current understanding of the way information is encoded, stored and retrieved from memory, we turn the spotlight to what is known about order in social psychology, namely the serial position and order effects. Knowing what is (un)known about order in social psychology leaves us with the clear notion that, from the person memory perspective, it is striking that memory models have neglected order information, a pervasive type of information of immense importance.

We finish the introduction by presenting an overview of a literature that has been thoroughly explored outside social psychology, namely in human memory research, and that specifically deals with the modeling of order information in memory. We review what is known about order from the human memory perspective to gain insights and inspiration for possible ways to model order information in person memory.

In detail, this introduction can be summarized as follows. The first chapter, entitled *Cognitive Representations of People and Person Memory*, is about the way social psychology has been dealing with the issue of (social) information representation in memory. More specifically, how people represent information about persons in memory. It stresses the representation of individualist information – i.e., information about persons – in a research area that has came to be known as person memory. The chapter starts by mentioning, in a nutshell, how social cognition, conceptualized as a level of analysis instead of a content area, contributed – both theoretically and methodologically – to the better understanding of the cognitive processes involved in the formation and use of mental representations of people (groups and persons). Secondly, the chapter points the spotlight towards the social cognitive approach to person memory research, particularly to impression formation. We consider what is an impression; what is the incongruency effect; the role these phenomena play in triggering research on person memory modeling; and how these phenomena are modeled in person memory. These are core topics of this section.

The second chapter of the introduction, entitled *Serial Position Effects and Order Effects in Social Psychology,* describes well-known serial position and order effects in impression formation. Then, after the inception of order effects, the second section of the chapter deals with an approach to model temporality in event memory, and its relation to person memory. Finally, the chapter ends with a discussion on the importance and necessity of order information and order representation in person memory modeling, as crucial elements to make sense of the world.

The third and last chapter of the introductory section, entitled *Memory for Serial Order in Human Memory*, describes the areas from the human memory research tradition in cognitive psychology that are crucial to the study of order in person memory. We argue, in line with social cognition tenets, that human memory literature can inform social psychological questions to a great extend. The chapter starts by describing the literature known as *memory for serial order*, which, in recent years, has generated an incredible amount of computer simulations, empirical research, and theoretical modeling to account for the encoding, representation, storage, and retrieval of order information in memory. This human memory literature has profoundly important role in enlightening the way order information can be represented in person memory. Different types of information are described, before presenting the three major theoretical proposals of memory for serial order: the positional, chaining, and ordinal theories.

Following the introduction, we will describe the theoretical proposal advanced by the current work, before presenting and discussing the experimental research that was conducted to test such ideas.

1. Cognitive Representations of People and Person Memory

1.1. Representing people in memory: Social cognition from the cognitive revolution to the present day

In this first section (1.1.), we will briefly mention how social cognition, understood as a level of analysis rather than a content area, contributed to the understanding of person memory and impression formation. That is, how the investigation of the cognitive underpinnings of person memory phenomena granted new insights into the way the cognitive processes underlying social thought and behavior operate. We propose to do so by emphasizing social cognition's theoretical and methodological contributions, focusing on the representation of people, namely on person memory.

1.1.1. Theoretical and methodological contributions

Advocating that social cognition should be conceptualized as a level of analysis (or *approach*, cf. Hamilton, Devine, & Ostrom, 1994) entails that irrespective of the social phenomena under scrutiny, social cognition approach will always focus on the investigation of the cognitive underpinnings of any given phenomenon. A necessary consequence is, thus, that there is no content area where social cognition research is developed but, instead, any given topic, content area or domain can be studied from a social cognitive perspective, as long as the emphasis is on the understanding of its underlying cognitive structures and processes. As such, social cognition cannot be defined has having a content or issue, but rather has an approach to any given social psychological content or issue. There is no content constraint, it is an approach that can be – and to a large extend *has been* – used in the study of any given topic within social psychology. Actually, social psychologists have pursued their diversified and miscellaneous research interests with an information-processing framework as level of analysis (Hamilton, 1981; Hastie, Ostrom, Ebbesen, Wyer, Hamilton, & Carlston, 1980; Higgins, Herman, & Zanna, 1981; Wyer & Srull, 1984; 1994). It should be noted that from the social cognition perspective, the study of the cognitive structures and processes is deeply intertwined. To fully understand one, it is necessary to understand the other.

Social cognition adopted the information-processing assumptions to study long-standing issues in the field. The social perceiver is viewed as an information processor. A person attends to, encodes, interprets, elaborates on, represents and retrieves information that is used to produce thought, judgment and behavior. The information-processing principles for social phenomena are assumed to be fundamentally the same for non-social phenomena.

The contribution of the social cognition approach, as a level of analysis oriented towards the understanding of the cognitive structures and processes of social psychological phenomena, span from intrapersonal (e.g., impressions, causal attribution, trait inferences, self, attitudes), interpersonal, and intergroup (e.g., social influence, stereotypes, prejudice, aggression, affect, group decision making) topics (Abelson, 1994; Berkowitz, 1999; Forgas, 1990; Hamilton, Stroessner, & Driscoll, 1994; Leyens & Fiske, 1994; Linville & Carlston, 1994; Mackie & Skelly, 1994; Monteith, Zuwerink, & Devine, 1994; Ostrom, Skowronski, & Nowak, 1994; Pennington & Hastie, 1992; Rothbart & Lewis, 1994; Smith, 1994; Wyer & Lambert, 1994).

One of the topics in which the social cognition research tradition has been central is the study of how people represent information about others in memory. Social cognition has contributed deeply to inform our understanding of person representations – *impressions* –, following the tradition of one of social psychology's most classical endeavors – the *person memory*.

1.1.2. Representations of people: Impressions, the person representations

Mental representations are among the core issues of interest in social cognition. Representations have often been described has the encoding of information in memory (cf., Smith & Queller, 2004). People form, maintain, and access representations that can be used to guide judgment and behavior. Much research has been devoted to the better understanding of mental representations in a variety of domains. In fact, pretty much all research topics in social psychology involve mental representations – e.g., in the persuasion literature, attitudes are (multi-dimensional) mental representations; in the study of the self, the self-concept is a mental representation as well; etc. One of the fundamental questions regarding representations is related to how such knowledge structures are built, that is, searching for how social information is represented in memory. Mental representations of persons can be structured in memory (Wyer & Carlston, 1994), as schemas (Wyer & Srull, 1989), exemplars (Smith, 1984, 1988, 1990), associative networks (Carlston & Smith, 1996; Hastie, 1988; Wyer & Carlston, 1979) or parallel distributed representations (Kunda & Thagard, 1996). The person memory research has been especially focused on the associative network framework, and that is be the theoretical approach that shall be further explored in the following section (1.2.).

The research tradition on impression formation has, at least, 63 years of cumulative knowledge. It all started in 1946 with a paper entitled "*Forming Impressions of Personality*" by Solomon E. Asch. This work – an undeniably seminal paper – triggered decades of research on impression formation and the representation of person knowledge, spanning several generations of illustrious researchers. Asch was exceptionally good in asking truly important questions (Garcia-Marques & Garcia-Marques, 2004). His work left numerous specific and decisive unresolved questions, whose answers have been pursued in the past decades. According to Asch, impressions were coherent, integrated representations of persons where inferential processes play an important role. As Garcia-Marques and Garcia-Marques (2004) noted, research on impression formation is one of those (rare) cases in psychology where over the course of time, the approaches that followed Asch (1946), especially the cognitive approach, built on Asch's original ideas, expanding and exploring them to the deeply understand of impressions' underlying processes.

We will now detail an integrative historical overview of the study on impression formation, since its inception until the current days, emphasizing three approaches (Asch, Anderson, and Social Cognition). We will argue that Social Cognition contributed dramatically to the study of impression formation, bringing the information processing paradigm to the study of person perception and memory.

1.1.3. Studying impression formation: A long history

Human beings (tend to) live in complex social societies. An important facet of such complexity is that people are constantly interacting with each other. To do so in a somehow efficient manner, people need to have memory of the social world. The impression we hold of someone plays a critical role in how we relate to them. For example, it helps to know that someone was friendly at a given moment, before jumping into a wholehearted hug in a subsequent interaction. Putting it simply, it helps to know, and memory is the place where knowledge lives. Impressions are, after all, knowledge entities about persons. We need to know how people are in order to guide what we think and do in our socially determined world. Thus, forming impressions about persons is something pervasive in people's daily lives. This very same issue has been interesting social psychologists since the early 1920s.

There are, at least, five major ways or *trends* in which social psychologists have looked at the way people form, develop, maintain and use person impressions, that inspired Garrido (2006) to advance five metaphors about the perceivers' role in impression formation (for an exhaustive review see Garrido, 2006). The first *trend* spanned from the early 1920s (Allport & Allport, 1921; Thorndike, 1920) to the late 1930s. Research focused on the accuracy and precision of social perception – *how accurate were people as perceivers*? As such, the first metaphor conceives the social *perceiver as a judge of character* (Garrido, 2006). The second *trend* started in 1946, and was triggered by Asch's seminal research. The attention was directed to the perceiver's processes in forming impressions, namely to the conceptualization of impressions as gestalt representations – *could a gestalt theory explain the way people form impressions*? The metaphor was that of a *perceiver as a pattern seeker* (Garrido, 2006). Third, the *trend* that followed was mostly interested in investigating the structure of personality impressions (Bruner & Tagiuri, 1954) – *what was the underlying structure of impressions*? The metaphor anchored, here, in the conceptualization of *perceivers as an implicit theorist* (Garrido, 2006). The fourth *trend* was concerned with the development of algebraic models to predict evaluative judgments (Anderson, 1962, 1965a) – *can an algebraic model represent the process of impression formation*? The metaphor conceived the social *perceiver as a data miner* (Garrido, 2006). Finally, the fifth *trend* focuses on the cognitive underpinnings of impression formation (Hastie & Carlston, 1980; Hastie & Kumar, 1979). This is what can be considered as the social cognitive approach to the study of person impression – *what are the processes and structures by which impressions are formed, maintained and used*? Here the metaphor conceptualizes the social *perceiver as a database manager* (Garrido, 2006).

We will now look to a subset of three of those five *trends*, the ones especially concerned with the processes involved in impression formation, and that played a critical role in shaping the development of research in impression formation to where it stands today: (1) Asch's gestalt proposal (second *trend*); (2) Anderson's algebraic models (fourth *trend*); and (3) the social cognitive process-oriented approach (fifth *trend*).

First, in what was called the second *trend*, one can literally say that the study of impression formation can be traced back to 1946, and to the groundbreaking work of Asch. Before Asch, social psychologists were merely concerned with the accuracy of social perception – how accurate where perceivers? (Bruner & Tagiuri, 1954; Jones, 1985; Leyens & Fiske, 1994). Asch turned the spotlight into the (perceiver's) processes involved in making sense about a person – that is, actually, impression formation. The question changed to "how do we come to know persons as distinctive psychological entities?" (Asch, 1952, p. 205). The theoretical proposal advanced by Asch (1946, 1952; Asch & Zukier, 1984) was that impressions were gestalt representations of persons. Asch (1946) demonstrated that different informational elements – for example, different traits – were organized into a unitary impression, as if elements were related amongst themselves, so that the impression is irreducible to its parts. Impressions were, therefore, organized, coherent, and integrated representations of persons. An impression would be substantially more than the collection of its discrete, individual, independent, and unrelated elements. Elements interacted to synthesize the meaning of the whole impression into a holistic representation. This is the gestalt view over the elemental, summative approach of impression formation. Asch's concern was to test whether a gestalt theory could explain impression formation. He did so in a set of experiments by adapting the classical verbal learning paradigm. Asch instructed participants to form impressions about a target person about whom they read a list of traits. Participants were then asked to perform three different tasks. Firstly, to write a brief description of the impression they had about the person. Secondly, to rank the traits according to their importance to the development of their impression. Thirdly, to choose the attribute that best suits the impression – that is, the target person –, from a list of 18 pairs of opposite meaning attributes. The main conclusions that were drawn from the variations Asch (1946) introduced in the list of traits, led him to discuss (a) the importance of central versus peripheral traits (Asch, 1946, Experiment I) – central traits had an exceptional importance in the sense they colored the way perceivers would interpret other traits; and (b) the importance of traits presented first versus traits presented last (Asch, 1946, Experiment VI) – the primacy effect showed the exceptional importance of the traits presented at the beginning of a sequence. These two findings – necessarily a subset of the array of findings provided by Asch's groundbreaking work[1] – contributed to the idea that impression formation resulted in the integration of traits in a general impression, in support of a gestalt conceptualization of impressions.

To test the (a) central-peripheral assumption, Asch (1946) gave participants, in two experimental conditions, a list with the exact same traits, with the exception of a single trait, located in the middle of the list. In one condition the middle trait was warm, and in the other was cold. A group read that the target was intelligent, skillful, industrious, warm, determined, practical, and cautious. The other group, instead of warm, read the attribute cold in the exact same position (intelligent, skillful, industrious, cold, determined, practical, and cautious). The variation in one single trait resulted in largely different impressions and largely different patterns of traits selected to describe the target. The warm condition generated more positive impressions and the use of more favorable attributes to describe the person, than the cold condition. To test the primacy assumption, Asch (1946) gave participants the exact same list of traits, varying exclusively the order of the traits in the list. In one condition participants read a list that started with positive attributes and proceeded to negative ones (intelligent, industrious, impulsive, critical, stubborn and envious), whereas in the other condition participants read the exact same list in the opposite order (envious, stubborn, critical, impulsive, industrious and intelligent). The resultant impressions were dramatically different.

1 Two other findings are also crucial in Asch's gestalt approach to impression formation, although they are less relevant to the scope of the present work, namely: the change of meaning effect (Asch, 1946, Experiment V) – the meaning of a given trait changes according to its immediate context, that is, depends on the attributes that accompany the trait –, and the holistic nature of person impressions (Asch, 1946, Experiment VIII) – when information describes more than one person, participants are unable to integrate the list of traits together, in a single person representation.

If in the first condition participants reported a positive impression with the corresponding positive attributes being selected to describe the target, in the other condition the opposite occurred. Participants reported a negative impression and selected negative attributes to describe the target.

The warm-cold effect, as sometimes the central-peripheral trait effect is named, together with the primacy effect, demonstrates that information is not all equal. Some information is more important than other. Peripheral traits are of lesser importance in the global gestalt representation, compared to the central traits in turn of which the impression is organized and built. In the same vein, the first traits in a sequence set the direction that the emerging impression takes, exerting a continuous effect on the interpretation of later information.

With these findings Asch (1946) argued that impressions were holistic person representations that resulted from the interaction of traits. The elemental assumption of impression formation would predict such results with difficulty. However, the historical significance and the legacy of Asch go well beyond the gestalt theory testing (Leyens & Fiske, 1994). Firstly, Asch was among the initiators of the process oriented research in impression formation, as opposed to the focus on the accuracy or validity of the impression formation outputs (Jones, 1990). The processes underlying impression formation, regardless of whether they were correct or incorrect, got irremediably into the bloodstream of impression formation research. Secondly, the legacy of Asch is also associated to the cognitive orientation that research on impression formation took from that moment onwards. He was the first to attend to, and emphasize, the cognitive aspect of impression formation (Asch, 1952). Thirdly, the innovations that Asch brought into the classic verbal learning paradigms, by using complex stimuli (not simple syllables) in experimental settings, opened the spectrum of possible studied domains (Garcia-Marques & Garcia-Marques, 2004).

Finally, Asch ingeniously demonstrated that it was possible to study individuals' and groups' cognition in controlled, lab environments (Garcia-Marques & Garcia-Marques, 2004). Asch is considered, not surprisingly then, the “absolute reference” (Garcia-Marques & Garcia-Marques, 2004) in impression formation research.

Second, in what was called the fourth *trend*, although absolutely in line with the approach focused on the intrinsic nature of the underlying processes of impression formation, Norman H. Anderson research program was dramatically different from Asch's one. One can argue that, metaphorically, Anderson was Asch's archenemy. Anderson was especially interested with the development and comparison of a formal algebraic information integration theory of impression formation (Anderson, 1971, 1981)[2]. Anderson's approach, which spanned over more than three decades, was in sharp contrast with Asch gestalt conceptualization of person impressions and, moreover, challenged Asch's assumptions of the processes underlying impression formation (Jones, 1985). Anderson was especially concerned with the way perceivers cumulatively combined and integrated different and discrete informational elements to produce a unidimensional evaluative judgment of a person, that is, an overall positive or negative impression. According to the proposal advanced by the algebraic models of impression formation, people consider all informational elements, compiling every single piece of the available information, in the representation of the target. The information integration mathematical models that were put forward as an account of impression formation were able to correctly summarize people's judgments about the personality of the target, with simple rules (Anderson, 1962, 1965a; 1967; Fishbein & Hunter, 1964). Several algebraic models were developed (Anderson, 1965a; Hendrick, 1968), with the additive model – an impression, or evaluative judgment, results from the mere summation of the different traits known about the person (Fishbein & Hunter, 1964) – and the

2 For a review of Anderson's approach over the Information Integration Theory (IIT), see Garcia-Marques and Garcia-Marques (2004), and Garrido (2006). For a modern application of the IIT to impression formation, see Kashima and Kerekes (1994).

averaging model – an impression, or evaluative judgment, results from averaging the different traits known about the person (Anderson, 1962) – stepping up as the most prominent theoretical proposals. Jones (1985) alerted us, however, to possible methodological reasons for such a collection of findings supporting the information integration algebraic proposal. In fact, given the experimental settings used by Anderson and others (Anderson, 1962, 1965a, 1967; Fishbein & Hunter, 1964; Triandis & Fishbein, 1963), instead of reflecting on sophisticated judgment strategies, such paradigms fostered participants' reliance on the use of simplified and heuristic judgment strategies, which can easily push the results towards the information integration assumptions. Furthermore, it seems to be the case that people form impressions in highly diverse settings, and not only in strict situations where information is integrated in a single judgment continuum, as shown by Rosenberg, Nelson and Vivekananthan (1968).

In a rare application of multidimensional scaling (Coombs, 1950; Kruskal, 1964a, 1964b; Shepard, 1962a, 1962b) to social psychological research, Rosenberg and collaborators (1968) demonstrated that the traits used by Asch are organized in a trait-space around two (almost) orthogonal evaluative dimensions, the social and interpersonal dimension; and the intellectual and mental ability dimension. The multidimensional analysis is a statistical technique that allows the placement of discrete elements (traits in this case) in an Euclidian multidimensional space. Rosenberg and colleagues (1968) found that the social and intellectual dimensions were sufficient to represent the trait information used in Asch's paradigm, as if forming impressions meant to place a target person in a space defined by the social and intellectual dimensions. Moreover, the central-peripheral hypothesis could actually be re-interpreted since the supposed central traits (warm or cold) were, in Asch's paradigm, the only informational elements representing the social dimension, in a set of traits portraying the intellectual dimension. Therefore, the warm-cold effect, or the increased impact of central traits, was not a necessary consequence of a trait-centrality principle, but rather the product of an inflated informativeness provided by a specific experimental context.

Third, in what was called the fifth *trend*, social cognition can be considered the final approach to the study of impression formation that lies on the tradition of thinking about the processes of impression formation and use. The social cognition approach can be characterized, even further, by an attempt to dive deeper into the waters of the cognitive basis of person perception and representation. Now, it was not only about (perceptive) processes, but also about cognitive processes of impression formation. Inspired by the comprehensive legacy of the earlier approaches (theories and methods), as well as by cognitive psychology (theories and methods), social cognition took this orientation to cognitive processes and structures, as opposed to descriptive outcomes of impressions, a step further – or a swim deeper – into the study of how impressions are formed, kept and accessed. It did so in a remarkable way, integrating into a critical analysis previous research and theory (Garcia-Marques & Hamilton, 1996; Garcia-Marques, Hamilton, & Maddox, 2002; Hamilton, Katz, & Leirer, 1980a, 1980b; Hastie, 1984, 1988; Hastie & Kumar, 1979; Sherman & Hamilton, 1994; Srull, 1981; Srull, Lichtenstein, & Rothbart, 1985).

The social cognition approach broke away from the approach of the Implicit Personality Theories (Bruner & Tagiuri, 1954, Cronbach, 1958) and its goal to describe the content of the mental representations of persons, in an attempt to understand how person representations interact with the processes involved in the information processing approach of social information. This framework advanced our understanding of what happens from encoding to retrieval and judgment (Wyer & Carlston, 1994), namely the cognitive operations that take place when information is perceived, the resultant cognitive mental representation of the transformed information, and the rules by which information is accessed and retrieved to generate behavior and judgment. In the following sections (1.2.1. and 1.2.3.), we will look in detail to the social cognition research tradition on impression formation, emphasizing the representational, or memory modeling, component of person impressions.

Summing up, from Asch and Anderson, to contemporary modern social cognition, the approaches on the study of impressions were focused on the perceivers' processes involved in forming impressions, rather than on the accuracy of normative models of impression or social judgment (Bruner & Tagiuri, 1954; Kahneman, Slovic, & Tversky, 1982). From Asch to person memory, social psychology was able to translate the changes that took place in psychological sciences into its own research arena, from perceptive processes to cognitive processes.

1.1.4. The contribution of social cognition to the study of impression formation (or how the study of impression formation adopted the principles of the renaissance)

In two consecutive years, 1979 and 1980, two papers were published that triggered the social cognition approach over person memory, generally speaking, and impression formation in particularly. These were the papers by Reid Hastie and Purohit A. Kumar, and by Dave L. Hamilton, Lawrence B. Katz, and Von O. Leirer, respectively. The first introduced the incongruency effect in person memory research. The second instituted the notion of impressions as organized cognitive mental representations about persons, and introduced the impression formation paradigm. Together, these two papers precipitated the immense endeavor that is known as person memory, both to account for the surprising and counterintuitive incongruency effect, as well as to conceptualize impressions as organized cognitive memory structures describing persons. In the following section (1.2.) we will define the current understanding of a person impression and we will detail the incongruency effect. Then, we will discuss the memory modeling efforts that have resulted from these seminal works to achieve a comprehensive understanding of the memory structure representing information about persons.

As we argued up to this point, person perception, or impression formation, is not only a research tradition with nearly a century (if we consider the first *trend*), but it is also one of the core research topics in social cognition. Overall, social cognition – and, in particular, the social cognitive study of person memory – is one of the freshest, most vigorous, auspicious, strongest and most innovative social psychological endeavors. Social cognition is a theory-driven approach oriented to develop and test models of social information processing. It is, furthermore, one of a kind theory driven approach, one that is particularly enthusiastic about the cognitive processes underlying social phenomena. Actually, we can borrow a cultural (and artistic) metaphor to illustrate social cognition contribution to social psychology, overall, and impression formation in particular. Social cognition, like the cultural movement that surfaced in Florence, Tuscany, as the middle age started to stumble in Italy, and that came to be known as the Renaissance, embodies a synthetic rebellion with the immediate historical conventions, bridging contemporary elements with longstanding classical issues. Social cognition embodies the synthesis and rebirth of the (cognitive) process oriented research in social psychology. As with the Renaissance artistic movement, we also have our Leonardo da Vincis and Michelangelos, the ones that lead the transformation and, most importantly, inspired others to continue the pursuit. Hopefully it won't be necessary to explicitly mention them, as we expect they will become evident as this introduction unfolds.

Some critical voices of the focus on the cognitive underpinnings of social phenomena that characterizes the social cognitive (Renaissance) approach, argue that social cognition has been drifting way from what really matters as regards the social psychological standpoint, that is, the impact social psychologists should have on the real world. This critique of how social cognitive low level of analysis has no direct application and impact in the real world and, thus, amputates social psychology's responsibility to contribute to change the world, has a parallel in some of the Renaissance's most fierce critics. Renaissance advances were questioned and taken as nostalgia for the classical Greek tradition. Others argued that the Renaissance represented, more than anything else, a continuity between eras.

We claim that the emergence of the social cognitive level of analysis, like the advent of the Renaissance, does not constitute a romantic, plaintive or nostalgic view over the (Greek) classics like Asch, but rather an extraordinary endeavor to advance our scientific knowledge about social memory in dramatic and expressive ways. The inspiration sought from the distant past was used to re-center the locus of research attention in the microscopic processes involved in impression formation. This inspiration, together with the new theories and methodologies from the cognitive revolution, created the ground for impressive theoretical developments that dramatically advanced our understanding about the social world in general, and impression formation in particular, by re-framing it in person memory. It is not that social cognition researchers disdained the social-world-impact component of social psychology but, instead, they relied on the complementary nature of social psychology research enterprises. Some emphasized basic knowledge, others built on top of such basic knowledge to impact the world.

Indeed, as we have been arguing, research on impression formation is one of the illustrious examples of cumulative research. It should be noted, however, the synthetic/blending component of social cognition – the combination of ideas from different origins that ended up being bridged together. This is, indeed, what our renaissance metaphor entails. Or, similarly, a metaphor of social cognition as the virtuoso musician. Like the virtuoso player of an orchestra, social cognition aces play different instruments, frequently at the same time.

We have been arguing that social cognition contributed to a better understanding of how people are generally represented in memory. We are, therefore, ready to dive into the deep waters of person representations. In fact, what we have been writing up to this moment has had the purpose of bringing a contextualized reader from the social cognition contribution to the study of mental representations, to what will be addressed from this moment onwards, that is, the representation of information about individuals – persons – in memory, also known as *impression formation*, or *person memory.*

1.1.5. Summary – *Section (1.1.)*: Representing people in memory, social cognition from the cognitive revolution to the present day

In this succinct section of the first chapter, we briefly addressed the historical context in which social cognition contributed to the study of mental representations of social information. The theoretical and methodological innovations of the social cognitive approach, inspired by the cognitive revolution and the information-processing paradigm, shed new light onto the way social psychologists were able to question the way people represent information in memory.

A long and fascinating story, from the emergence of social psychology, to the present day, passing quickly through the inception of the social cognitive level of analysis, was shortened to convey the simple idea that social psychological research on the mental representations of people, informed by social cognition, has been building up cumulative knowledge to leave us where we are today, with an impressive array of findings and insights about the way representations of people are built, kept, accessed and used. From this point, we are now ready to move onto the detailed specification of such a comprehensive knowledge about person representations, i.e., *person memory.* So, now we are ready to define an impression and describe the incongruency effect, and thus consider the person memory modeling that was developed to cope with such phenomena.

1.2. Person Representations: Impressions in Person Memory

Section 1.2. is dedicated to person memory. We will start with a tentative definition of impression, followed by a detailed analysis of the incongruency effect, before focusing on the modeling issue of person information in memory, or how impressions are represented in memory and how we can account for the incongruency effect. Finally, a description of the elements of the associative network person memory models – the different nodes and the associative links between them – assumed to be the instances by which information is represented in the person memory structure, i.e. impressions, will be discussed.

1.2.1. Impression: A definition

So what is really an impression? The term impression is often used to describe the cognitive mental representation of a person (Hamilton, et al., 1980a, 1980b; Srull & Wyer, 1989; Wyer & Carlston, 1994). Impressions are composed by several facets of one's knowledge about a person (Hamilton, Driscoll & Worth, 1989). Firstly, the information about a person that was acquired by the perceiver – the *perceived/raw information*. Secondly, the inferences that were drawn based on the perceived information about the person – the *inferred information*. Thirdly, impressions also include a general evaluative concept about the target person – the *evaluative information*. Furthermore, impressions also include category-based information (e.g., appearance, facial features, stereotypes, etc.), culture-based information, and information learned from other people.

As we have seen, the attempt to understand impression formation has a history of more than 60 years, starting with the pioneering work of Asch (1946). According to Asch, impressions were gestalt, unified and integrated representations of a target. In the recent decades, the focus shifted towards the core underlying cognitive processes and structures of impression formation. This approach adopted the principles of the information processing paradigm to understand the processes underlying the formation of personality impressions. That is, researchers have been trying to understand impressions focusing on the processes that go from the acquisition of information about a person, to the representation, storage and retrieval of that information from memory (Srull & Wyer, 1989). Over the years, research has been concerned with two fundamental questions. The first, based on the information processing paradigm, is related to the way we encode, represent (and retrieve) information about a person. This research is best known as person memory. The second is the way these representations impact later judgments and behaviors.

The current thesis emphasizes the person memory component of the research in impression formation. We are mostly concerned with the way information about a person is represented in memory. Moreover, we are concerned with the processes by which order information – i.e., information about the sequentiality, or temporality, of a piece of information in a string of elements of information – is encoded, represented and retrieved in the mental representations we build about persons.

The first known definition of an impression as a cognitive representation of a person was introduced by Hamilton and colleagues (1980a). These authors propose that an impression is built through a process where information is integrated in an organized person impression. This process is described as an active process that will organize the available information portraying the target person. Perceivers form impressions seeking to reach a coherent representation of the person. This mental representation has the information that was perceived, as well as the information that was inferred from the original stimuli. At the most fundamental level, Hamilton and colleagues (Hamilton, 1981; Hamilton, et al., 1980a) describe the process of forming an impression as inherently involving the integration of all information available about a person into an organized cognitive representation of that person.

In more detail, Hamilton and colleagues (1980a) propose that such a memory structure emerges through different organizational processes. First, as the perceiver receives new elements of information – items –, each new item is related to the items that were perceived before. Second, the relational processing will result in the formation of associations between the representations of each item in memory. Third, the memory structure expands as more items are perceived and represented. Fourth, the inter-item associations, organized in a network of associative links, that characterize the impression, facilitate the retrieval of information from the memory structure that was formed about a person.

Since Hamilton and colleagues (Hamilton, 1981, 1989; Hamilton, et al., 1980a), much of the study on impression formation, within the person memory approach, has used the impression formation paradigm introduced by these authors. The special significance of the impression formation paradigm relies on the relevance that is given to processing goals, and their mnesic consequences, to better understand the memory structures that are built when people form impressions. Participants are instructed to form an impression about a target person, they study a list of behaviors that were performed by the target and, later on, they are asked to recall the information that was studied. By analyzing the recall protocols, researchers expect to have an insight as to how information was encoded to represent that person in memory. The impression formation paradigm relies on the contrast of impression formation processing goals with memory processing goals. The reason for such a comparison relies on the assumption that a memory processing goal would not lead to such an organized structure in memory since perceivers have no need to impose a coherent organization to that representational structure. Therefore, less cognitive effort is invested in interrelating the items.

So, Hamilton and colleagues (1980a) not only postulate that impression formation is a processing goal with mnesic consequences but, furthermore, they specify these mnesic consequences. Indeed, one of the most replicated findings supporting the information integration, or organization, proposal (Hamilton, et al., 1980a, 1980b) is the increased recall performance in retrieving items from memory when participants have formed an impression rather than having memorized the information. The idea that organization facilitates recall performance was well-known (Bower, Clark, Lesgold, & Winzenz, 1969; Tulving & Pearlstone, 1966), thus, the retrieval advantage for impression formation supports the idea of an organized memory structure of the target person, with inter-item associations. This organization, assumed to be a natural consequence of the impression formation process, uses each item as a retrieval cue to retrieve other items that have become associated in memory, resulting in the typical recall advantage that is often found (Hamilton, et al., 1980a). As such, recalling an item will facilitate the retrieval of further items.

In the original paradigm of Hamilton and colleagues (1980a, 1980b), participants were presented with 20 behaviors, describing five personality traits (4 behavioral descriptions for each trait). Half of the participants were instructed to form impressions, and the remaining half was instructed to memorize. Results indicate that participants in the impression formation condition recalled more behaviors and, moreover, recall takes place in clusters by trait. According to Hamilton and colleagues (1980a, 1980b), these two findings jointly contribute to support an organization trait-based memory model for person impressions. The assumption underlying this model is that impression formation results in heightened trait inferential activity, that results in memory trait based representations of a person (Hamilton, 1981, 1989; Hamilton, et al., 1980a).

An alternative account to the role of organization in impression formation is provided by Klein and colleagues (Klein & Loftus, 1990; Klein, Loftus, & Schell, 1994). These authors challenge the organizational model of social information representation, as postulated by Hamilton and colleagues (Hamilton, 1981; Hamilton, et al., 1980a, 1980b), providing an alternative memory model where behavioral episodes are stored independently in memory, irrespective of whether they are illustrative of the same trait or not. According to Klein and Loftus (1990) elaborative-encoding account of impression formation, retrieval is the key element for the trait clustering found in recall protocols, rather than the memory representation. Moreover, not only trait clustering, but also the typical results obtained by the impression formation paradigm, namely the recall advantage of the impression formation conditions, can both be explained independently of the trait organization and inter-item associations that are assumed to be built in the memory structure representing the target (Hamilton, et al., 1980a). That is, the trait clustering is not the outcome (Klein & Loftus, 1990) of trait based representations (Hamilton, 1981, 1989) but, instead, a byproduct of retrieval processes. In questioning the role of organization in impression formation, Klein and Loftus (1990) offer a different perspective of the memory structure that represents a person. It should be noted, however, that Klein and colleagues objections are restricted to the mnesic consequences of the impression formation processing goal advanced by Hamilton and colleagues. That is, it is argued that forming an impression, according to Klein and collaborators, does not result in a trait-based organized person representation. Importantly, Klein and colleagues do not dispute that impression formation, by itself, is a processing goal with important mnesic consequences to understand person memory. Klein and colleagues' proposal constitutes, as such, an alternative explanation to Hamilton and collaborators mnesic consequences of the impression formation processing goal, not an alternative explanation to person memory, the impression formation paradigm or, moreover, the seeds that were launched from the research program by Hamilton and collaborators.

Four sets of models can be used to represent such a memory structure – an impression. These models can be arranged in models describing “which” information is represented (*schemas:* Wyer & Srull, 1989; and *exemplars:* Smith, 1984, 1988, 1990), and models describing "how" information is represented (*associative networks:* Carlston & Smith, 1996; Hastie, 1980, 1988; Wyer & Carlston, 1979; and *connectionist models:* Kunda & Thagard, 1996; Van Overwalle & Labiouse, 2004). Both episodes and abstractions can be represented within associative and connectionist models. Still, any examination of the impression formation literature indicates that schemas and associative networks are the prevalent modeling options. On the one hand, such a memory structure could be accounted by the schema theory, as proposed by Rumelhart and Ortony (1977). According to this view, impressions could be seen as representations with various schematic data structures. On the other hand, the associative network models of person memory (see 1.2.3.), portray such a memory structure as a set of inter-item associations represented in a network, where the target person is the central node, or person node. Items are associated with the person node and are associated among them. An impression, as stated by the model, is an associative network where features of a person are represented by nodes in memory and relationships between nodes are represented by associative linkages (Srull & Wyer, 1989). As such, an impression is constituted by a target person node, and the items describing the person. Items are connected to the target node by vertical associative links[3].

Several investigators have developed associative network models (further specified in the following section. 1.2.3.) based on the idea of traits as organizing principles in memory (Gordon & Wyer, 1987; Srull & Wyer, 1989; Wyer & Gordon, 1984; Wyer & Srull, 1989), further specifying the representation of items (behavioral episodes) and traits in the person

3 During encoding, associations between items can be established by direct associative pathways – inter-item linkages. The inter-item associations are more likely to be created when incongruent information is encoded, as compared to congruent information. The person memory model (Hastie, 1980; Srull, 1981) also postulates the retrieval processes that are assumed to be the basis of the incongruency effect and that reflect the way information is retrieved from memory.
When more than one trait is presented, a trait based representation is assumed to be developed where a trait node is represented in an intermediate level, and operates as an organizer of items in the memory structure. Items illustrating a given trait are vertically associated to that trait which, in turn, is associated to the target node (Hamilton, et al., 1989; Hamilton, et al., 1980a, Srull & Wyer, 1989).

memory structure. Regarding encoding, inferring a trait from a behavior will lead to the development of an association in memory between the behavior and the inferred trait. If there is more than one behavior portraying the same trait, then the trait becomes a "central" node (Klein & Loftus, 1990) that is associated to all the behaviors that are illustrative of that trait – behaviors are, therefore, represented in an organized trait-cluster fashion. At retrieval, participants will access a trait cluster – i.e., trait node and the behaviors attached to it –, and will report the content of the trait-behaviors cluster. That is, all the behaviors that are associated to the trait node and that imply that trait. This process is thought to be the basis of the recall advantage and the trait clustering found in recall protocols in impression formation.

Given that connectionist models are elaborated, implementation-level, re-descriptions of associative models, most researchers nowadays do not literally ascribe to associative models, especially when all the person-memory associative models are easily re-cast as connectionist models. However, for reasons of clarity and simplicity, during the present thesis we will discuss at the level of implementation of the person memory associative models.

1.2.2. The Incongruency effect

Let us start with a fairy tale. There was a time when witches were abundant. As usual, witches were mean, with evil magic powers. They would bake cookies to poison innocent children. They would fly their brooms to frighten people. They would make spells and all kinds of witchcraft. Well, witches were just being witches. Now imagine that you were walking through the woods and, without being seen, you spotted a witch. Probably you would be petrified. Ok, calm down, you were not spotted. In a flash, you look around and you notice a small hideaway. Very quietly and gently you enter the improvised shelter. So there you are, trapped inside a tree that has a tiny little hole from where you can see the woods and the witch, witching just in front of you. The witch is cooking, probably baking the poisoned cookies as well as the evil potions. Meanwhile, the witch trains her most horrendous facial expressions in front of a mirror, grabs the broom and exercises her most frightening flying moves. Now, while waiting for the cookies, the witch sits in a wooden bench and starts reading. What the heck! She smiles while reading Karl Popper's “The Logic of Scientific Discovery” (Popper, 1959).

Apart from the inception of the impression formation paradigm and the conceptualization of impressions as organized memory structures, person memory research was also catalyzed by Hastie and Kumar's (1979) discovery of the incongruency effect. This finding has been theoretically explained by an associative network person memory model[4] (Hastie, 1980; Srull, 1981; Srull & Wyer, 1989). Actually, the person memory model was developed to account for the incongruency effect (Srull & Wyer, 1989). The paradigm introduced by Hastie and Kumar (1979) proved extremely useful and was extensively used in an impressive array of subsequent investigations that contributed to the development of person memory and, more specifically, to help answering the representational question of impression formation.

When the social perceiver forms impressions about a person the goal is to reach a unified representation of that person's personality. This idea of an impression as a unified, gestalt representation goes back to Asch's (1946) work on impression formation. People form impressions to make sense of others they encounter and impressions are integrated representations of those persons' characteristics. However, when one perceives information about a person, it is common to perceive information that is diverse and inconsistent. The same person can behave intelligently (e.g. win the chess tournament) and stupidly (e.g. leave his windows open while washing the car). How can the perceiver form a unified, integrated, gestalt representation if there are pieces of information that are contradictory?

4 Specified in the following section 1.2.3.

In the late 1970's, research on impression formation came across a fascinating and intriguing effect. When people were asked to remember information about a target person, information that was incongruent with a prior expectancy describing that person was better remembered than information that was congruent with the expectancy (Almeida, 2007; Garcia-Marques & Hamilton, 1996; Garcia-Marques, et al., 2002; Hamilton, et al., 1989; Hastie & Kumar, 1979; Jerónimo, 2001, 2007; Srull, 1981; Srull, et al., 1985; Wyer & Martin, 1986).

The incongruency effect (or inconsistency effect, according to some authors, cf. Ehrenberg & Klauer, 2005; Sherman, Lee, Bessenhoff, & Frost, 1998; Srull & Wyer, 1989), as it was called, is this recall advantage for expectancy-incongruent information. This memory retrieval counter-intuitive effect was first described by Hastie and Kumar (1979), triggering a huge amount of research on person memory to account for it (for meta-analytic reviews of the incongruency effect, see Rojahn & Pettigrew, 1992; Srull & Wyer, 1989; Stangor & McMillan, 1992). In the original study, participants were instructed to form impressions and recall information about six fictional characters. Participants studied six lists with 20 sentences. Each list was associated with a different trait, containing 12 sentences describing behaviors congruent with a personality trait, 4 sentences describing incongruent behaviors with that trait and 4 sentences describing neutral behaviors regarding the trait. In total there were 12 traits in the stimulus material, and so two sets of 6 traits were randomly created as replication of the material. Each participant received the six lists in a different order (organized in a Latin square plan to assure that each trait appeared in a different position for each participant). Before each list, participants read aloud eight trait adjectives to induce the trait expectancy for that list. Finally, after reading the set of six lists, participants were instructed to freely recall as many sentences as possible.

Results showed that incongruent behaviors were better recalled than the congruent and neutral behavioral descriptions. In follow-up experiments, Hastie and Kumar (1979) showed that the incongruency effect was dependent on the proportion of congruent-incongruent behaviors in the lists, with the strongest incongruency effect being found for the lists with fewer incongruent behavioral descriptions.

In the research program to cope with the incongruency effect, the basic Hastie and Kumar (1979) findings have been extensively replicated (e.g., Bargh & Thein, 1985; Belmore & Hubbard, 1987; Crocker, Hannah, & Weber, 1983; Hastie, 1980, 1984; Hemsley & Marmurek, 1982; Srull, 1981; Srull, et al., 1985; Stern, Marrs, Millar, & Cole, 1984; Wyer & Gordon, 1982; Wyer & Martin, 1986). However, most of these studies employed behavioral information that is always congruent, or incongruent with a specific trait dimension. The fact that perceivers learn about, and base their impression on, one single personality trait, poses a serious constraint to the generality of these findings (Hamilton, et al., 1989). Hamilton and colleagues (1989) expanded their original multi-trait paradigm (Hamilton, et al., 1980a) to account for the incongruency effect, having the associative network model as a framework. Although Hamilton and colleagues (Hamilton, et al., 1980a, 1980b) did not present an associative network framework to account for their original findings, later on (Hamilton, et al., 1989) they expanded and integrated earlier findings within Hastie and Srull (Hastie, 1980; Srull, 1981) associative network models of person memory.

The incongruency effect is an unexpected, intriguing, counter-intuitive effect. Although incongruent information is better remembered, compared to congruent information, incongruent information does not lead to changes (at least to a certain degree) in knowledge structures such as impressions (Asch, 1946; Hastie & Kumar, 1979) or stereotypes (Hamilton, 1981). Additionally, impression judgments are less influenced by incongruent information than congruent information (Carlston, 1980; Hastie & Kumar, 1979). From the theoretical point of view, at that moment, the incongruency effect was a surprising effect in terms of the predictions of simple schema theories (Mandler & Johnson, 1977), organization theories (Bower, 1970) and prototype theories (Cantor & Mischel, 1977). All these theories predicted that fitting, or congruent information, would be better recalled than incongruent information. From the empirical point of view, before Hastie and Kumar (1979), there were only a few studies pointing in a similar direction, that is, showing that people remember well novel (Greenwald & Sakumura, 1967), distinctive (Hamilton & Gifford, 1976) or schema-incongruent (Smith, 1973) information.

Although extremely robust and widely replicated, the incongruency effect is not obtained across the board. There are several known changes in experimental conditions (e.g., Bargh & Thein, 1985; Ehrenberg & Klauer, 2005; Dijksterhuis & van Knippenberg, 1995a, 1995b; Fyock & Stangor, 1994; Macrae, Hewstone, & Griffiths, 1993; Srull, 1981; Srull et al., 1985; Stangor & Duan, 1991; Wyer & Martin, 1986) that affect the way the incongruency effect is expressed and that lead to important revisions of the original person memory model (Garcia-Marques & Hamilton, 1996; Garcia-Marques, et al., 2002; Srull & Wyer, 1989; Stangor & Ford, 1992). For example, recently Ehrenberg and Klauer (2005) showed that item memory plays a minor role in the incongruency effect, suggesting instead, that source memory is vital to explain the advantage for incongruent information.

1.2.3. Person memory modeling: Accounts for (impression formation and) the incongruency effect

Now that we know what an impression is, and what the incongruency effect actually mean, how can a knowledge structure be modeled in person memory to account for both? That is, how can a memory model represent person information and explain the incongruency effect. With the conceptualization of impressions as cognitive representations – i.e., memory structures – the issue of how to model impressions in memory came under the spotlight in impression formation research.

In this section we will review in detail several different models that account, either directly or indirectly, for the incongruency effect. The section is organized in three parts. Firstly, we will discuss the explanations of the incongruency effect that fall under the antecedents of the person memory model (section 1.2.3. i – *The seeds*). Secondly, we will discuss the person memory model itself (section 1.2.3. ii – *The person memory models*), that accounts for the representation of person impressions, and explain the incongruency effect. Thirdly, we will discuss the set of alternative accounts that have been put forward to explain incongruency (not always in person memory) (section 1.2.3. iii – *The alternatives*).

We will start by discussing the early (and incomplete) explanations of the incongruency effect that sowed the seeds of the person memory model explanation that emerged later. As such, we will describe the von Restorff (1933, cited by Koffka, 1935) effect, followed by the schema theory (Bartlett, 1932; Schank & Abelson, 1977), the human associative memory (HAM) model by Anderson and Bower (1973), and the levels of processing (LOP) approach by Craik and Lockhart (1972). Both the HAM and the LOP were at the heart of the development of the person memory model (Hastie & Kumar, 1979; Hastie, 1980). The HAM was put forward as a theory of human memory that conceptualized memory as an associative structure where discrete elements are associated in a hierarchical network. The LOP asserts that memory performance is the result of information being processed at different levels, rather than the consequence of distinct memory systems. Hastie and Srull (Hastie, 1980; Hastie & Kumar, 1979; Srull, 1981) adapted and extended the basic assumptions of the HAM and unfolded the first memory model of impression formation, the person memory model. After discussing the person memory model, we briefly turn our attention to the most recent associative person memory model, the twofold retrieval by associative pathways model (Garcia-Marques & Hamilton, 1996; Garcia-Marques, et al., 2002). Finally, we will discuss the alternative models that have been put forward to explain incongruency, namely the item vs. relational processing proposal (Coats & Smith, 2006), the encoding flexibility model (Sherman, et al., 1998), the flexible use of source information model (Ehrenberg & Klauer, 2005), the trait inference inhibition model (Jerónimo, 2007), and the semantic and episodic memory distinction proposal (Almeida, 2007).

i) Modeling the incongruency effect – Take 1: The seeds

From the four accounts of the incongruency effect that came before the person memory model, only the HAM and LOP proposals were direct sources of theoretical inspiration for the development of the person memory model. Nevertheless, long before the incongruency effect was unveiled in social cognition, research on human memory came across the von Restorff effect, a distinctiveness based effect. Although the accounts of the von Restorff effect are insufficient to fully understand the incongruency effect, the distinctiveness-based explanation was one of the possibilities firstly considered to cope with the incongruency effect. Likewise, the popular schema theory was also put forward as a possible explanation for the incongruency effect, but was unable to account for the representational question of person memory.

However, the theoretical ideas that were discussed by Hastie and Kumar in their 1979 seminal paper, as possible explanations for the incongruency effect, and that constitute the actual seeds that launch the rudiments for the development of the person memory model, are the LOP approach and the associationist network ideas. These two streams of literature were examined together, as the basis of an integrative theory of social memory. It is, thus, essential to understand them to discuss the person memory model.

i.i. von Restorff effect

In the human memory literature, there is an effect that, at a superficial level, looks like the incongruency effect – the von Restorff effect, or alternatively, the distinctiveness or isolation effect (Hunt & Lamb, 2001; Kelley & Nairne, 2001). This is a powerful effect that "difference" can have on memory. Such an effect was first studied in a paradigm developed and implemented by von Restorff (1933, cited by Koffka, 1935). First, participants saw a list of 10 unrelated items. One day after, participants received a list in which 1 item was different compared to the other items on the list. Two days after, another list with another different item was presented to the participants. Delayed recall results indicate that memory is always better for the different, or isolated item, as compared to the other items. The von Restorff effect refers to this memory enhancement for the items that deviate from the context (i.e. better memory for isolated items).

The isolation effect has been seen in terms of the beneficial effects of distinctiveness on memory (Schmidt, 1991). This view, that conceives distinctiveness as a property of the stimulus, can be traced back to James (1890), and later to von Restorff (1933, cited by Koffka, 1935) and the Gestalt approach. The standard account for the isolation effect, or von Restorff effect is that distinctiveness is a property of the items (surprise or salience, Green, 1956), that draws extra attention, resulting in additional processing at encoding. Humphreys (1976) made the case for an alternative proposal that integrated the levels of processing and organization approaches, where the optimal encoding entailed both the relationship among items, as well the items themselves. Such explanation for distinctiveness is based on different forms of processing, rather than on the nature of the information itself.

But the recall incongruency effect in person memory initially presented by Hastie and Kumar (1979) has been obtained in settings were incongruent items are not distinctive. The manipulation of the incongruent information set size has indicated that the incongruency effect is found namely in settings where the same number of congruent and incongruent items exists in the stimulus material (Hastie & Kumar, 1979) and where incongruent items outnumbered the congruent ones (Srull, 1981). Thus, in such contexts, there is no distinctive component associated to the incongruent information, apart from being contrary to the initial expectancy. Therefore, the explanation of the incongruency effect based on distinctiveness, apart from relying heavily on the properties of the items, falls short of explaining the entire incongruency phenomena from a person memory perspective. That is, based on the memory structures that result from processing differences of congruent and incongruent information.

i.ii. Schemas

When research on impression formation stumbled upon incongruency, the existing models in the social psychological literature were unable to cope with it. It should be noted that, by then, schema (or prototype) models dominated the conceptualization of person impressions, predicting that congruent information, fitting the schema structure, would be better recalled. Moreover, the schema theory was at odds with the conceptualization of impressions as memory structures that are created through a process of information integration.

But what is, then, a schema? The notion of a schema, frame or script (Bartlett, 1932; Carlston & Smith, 1996; Fiske & Taylor, 1991; Schank & Abelson, 1977; Smith & Queller, 2004; Wyer & Carlston, 1994) postulates a mental representation that is a structured unit of knowledge – data structure – of an item (concept or object). Schemas represent abstract knowledge, in opposition to episodic knowledge that is always associated to a specific time and context. A schema has a central principle, or a stereotyped action sequence, whose activation is triggered by some initial information. Once a schema is activated, all the knowledge contained in such data structures becomes immediately accessible. The more a schema is accessible, the more likely it will become active. Schema activation is influenced by recency and frequency of use. It is assumed that schemas are independent knowledge structures, so that the activation of a schema does not imply the activation of other (un)related schemas. Activated schemas can affect memory retrieval and judgment by serving as retrieval cues – usually facilitating the retrieval of schema-consistent information – and by having a reconstructive guessing function when retrieval fails. The analogy that is most often used to illustrate a schema is the representation of dining at a restaurant.

The person memory model emerged at a time when schema theories of memory where dominant. However, these schematic mental representation theories where inadequate since they did not specify the representational and processing features of the memory structures, which were the core aspects of interest in the information processing approach of the social cognitive perspective over the structure of the memory representation of social information. Moreover, from the inception of the ideas of incongruency and impressions as organized cognitive person representations, and given the schema theory's inability to provide a proper account to the phenomena, research programs have been in search of alternative theories to explain these novel effects and ideas. Inspired by the cognitive revolution and the socio-cognitive level of analysis in social psychology, authors looked for two theoretical arguments that were gaining ground outside social psychology. One was the associative network modeling (namely the HAM and FRAN models), the other was the levels of processing approach. However, since such models were still unable to explain the specificity of the incongruency effect, as well as the notion of organized impressions, the theoretical efforts that have been made were conducive to the development of the person memory model.

i.iii. <u>Human associative memory model</u>

Hastie was, nonetheless, particularly attentive to the theoretical developments taking place in the human memory literature, namely the introduction of the recent notion of associationism into memory modeling. So, in search for a memory account of the incongruency effect, the associative network models of human memory were a good source of inspiration.

In a time where schema theories of memory dominated the literature, John R. Anderson developed a computer simulation model of free recall – FRAN (Free recall in an Associative Network) model (Anderson, 1972). By then, most of the research that was being done on memory was concerned with sentences or larger linguistic units. FRAN is a memory retrieval model to cope with the processes underlying free recall. The memory structure in which FRAN operates is an associative network. However, although FRAN was built on an associationistic data base, it was unable to cope with the complexity of language. According to FRAN, sentences were simply strings of unrelated words (the nodes were words and the associations among the nodes were semantically undifferentiated). However, shortly after, driven by the search for an integrative theory of human memory, Anderson and Bower (1973) developed an associative model for the organization of human declarative knowledge in long-term memory that was able to represent information in sentences and the way they were learned and remembered. The Human Associative Memory (HAM) model advanced by Anderson (Anderson & Bower, 1973) is built on associative processes implemented on a hierarchical memory structure (Posner, 1974). HAM is able to account for the encoding, retention and retrieval of information in a variety of environments, integrating and explaining findings from fields that span from sentence memory, language, comprehension, long-term memory search, verbal learning, forgetting and memory, among others.

HAM adopted the principles of the information-processing approach, conceptualized as a methodology for theorizing rather than a methodology for experimenting (Anderson & Bower, 1973), to understand and speculate about the mental structures and processes underlying behavior. According to HAM information is processed in a mental system through a variety of processes. Although the model specifies the mental structures and processes by which information enters the system, is transformed within the system, is stored in memory and is used to produce outputs, the main focus of attention from the theoretical point of view is with the memory component of the system, the memory (sub)system. As other contemporary memory models (e.g. Simon & Feigenbaum, 1964), HAM is a neo-associationist conception of human memory in the form of a computer simulation model. Although the theory was originally implemented as a model of sentence memory, it outlived the specificity of its initial implementation and came to be highly influential in memory theorizing and modeling.

Basic informational units, representational structure and processes

As an associationist model of memory, HAM clearly states that knowledge is represented through a set of basic information elements (memory nodes – the most elemental units) that are associated among themselves. The basic information units of HAM are (a) the semantic primitives (simple ideas, the nodes), (b) the complex ideas derived from the semantic primitives, and (c) the associations among these units. The nodes represent individual concepts people have in memory. This representation stores all that is known about the concept, namely the meaning of the concept. Relations among the nodes are represented as (semantic) associations. The combination of these elements results in propositional structures (i.e., propositional trees and subtrees), a higher-order level of analysis. Propositions are configurations of interconnected nodes representing basic concepts (Anderson & Bower, 1971, 1972b) and are structured under the guidance of syntactic principles, enabling people to relate to network structures and to their meanings (Anderson, 1976). As such, declarative knowledge is represented in memory in a propositional way. As opposed to traditional associationist models, HAM goes beyond simple associations between units, suggesting that associations can indeed represent distinct types of relations between units by means of semantic associations (Anderson, 1972). In summary, the HAM model conceives the memory system as a hierarchical structure rooted in a sweeping associative network of interconnected propositions. The network is constituted by nodes and semantic associations among them.

Regarding the representational structure, sensory parsers convert the raw input from the outside world into propositional representations that can be treated by the memory system. In the case of sentence processing, the parser will produce a propositional tree structure for each proposition within a given sentence. Each proposition is independent and it is represented by a different network of nodes. Thus, propositions are represented in memory as tree structures. The tree is composed by nodes (the ideas) that are interconnected by semantically labeled associations (labels indicate the semantic relation between nodes).

The general nodes in which the propositional tree is built are assumed to be already represented in the memory structure. General nodes represent the ideas of each concept, before the sentence is perceived. On the other hand, the entire structure above the concept nodes, namely propositions, will establish new labeled relations among the existing concept nodes in an associative structure, bringing meaning to the general idea, as well as novel information into the memory structure. To encode information in memory, the linkages that are created in working memory need to be converted into long-term memory associations. To retrieve information from memory, a probe tree is constructed remaining in working memory while the system searches for a matching tree in long-term memory. The tree that best matches the probe will be the output. If the output is unsatisfactory, the system can develop further probes.

The top node of a propositional tree is the total (propositional) idea. Each tree has a binary structure, being composed by two sub-trees: the contextual subtree (representing the idea of the context) and the fact subtree (representing the idea of the fact). The context node is composed by two nodes, the node representing location and the node representing time. The fact node is also composed by two nodes, a node representing the subject and a node representing the predicate. Finally, the predicate node can itself be divided in two nodes, a relation node and an object node.

Regarding the set of processes that operate on the memory structure, apart from the already described “parser” process, HAM considers two additional processes, the “match” and the “identify” processes. The match process is a parallel search process that checks whether an input tree (or probe) is already represented in memory. If there is a match, the search stops and nothing is stored. If there is a partial match, then the portion of the tree that is new will be kept. If there is no match, the entire tree is stored. The identify process is a control process to prevent unreasonable structures being built on memory from partially matched inputs. It does so by checking how much of the information that was matched is useable for encoding the input. It is a process that identifies and differentiates the links from the matched input that can definitely be used, from the links that will have to be encoded as new information. Taken together these three processes – parser, match and identify – are the core processing assumptions of HAM.

The retrieval component of HAM, although developed to account for recognition and fact retrieval processes, was greatly inspired in FRAN (Anderson, 1972), naturally emphasizing free recall. It posits an associative strategy for free recall built on an associative network structure in long-term memory. However, although HAM is greatly inspired in FRAN regarding retrieval, there are important differences that should be noted. According to FRAN, the basic nodes in the network are words. HAM goes beyond this simplistic conceptualization of the basic information units as words by stating that nodes represent individual concepts people have in memory. Moreover, HAM, and not FRAN, differentiates associations. As stated by HAM, associations are semantically labeled. FRAN, on the other hand, assumes only undifferentiated associations amongst the information units in the network. Finally, FRAN represents the context as basic information units, or nodes. Conversely, HAM represents the context propositionally. Above and beyond these important differences, FRAN and the retrieval component of HAM are very alike (Anderson & Bower, 1972a, 1973). In free recall tasks the entry node is randomly selected. Information is retrieved by associative chaining in a search process that transverses the associative network following the serial associations that stem from any given entry node. On top of this, a recognition process will determine whether any given node that is retrieved was present on the stimulus list or not. This retrieval processes will continue until no further information is accessed from the given entry nodes.

HAM provides the associative memory structure framework for the representation of person impressions and the incongruency effect. However, although it details the memory structure, is does not specify the mechanisms that give rise to the incongruency effect. In fact, HAM is unable to account for the reasons on the basis of the incongruency information advantage in free recall tasks. HAM, as a general theory of human memory, explicates the representation of information in an associative network without specifying further how distinct types of information can be represented differently in the memory structure. As such, according to HAM, there was no reason for the better recall of incongruent information. It suggested, though, that congruent and incongruent information should be represented differently. This is the reason that led Hastie and Kumar (1979) to integrate the associationist ideas of HAM with the levels of processing approach, that will be now reviewed, to understand how congruent and incongruent information could be differently represented in the associative memory structure to account for the incongruency effect.

i.iv. Levels of processing approach

Craik and Lockhart's (1972) LOP postulated that information that is encoded at a deeper level, as opposed to a shallow level, will result in better memory for the to-be-remembered information. That is, information that is encoded for its meaning is more memorable than information encoded, for example, in terms of the way words sound. This idea, inspired in Hyde and Jenkins' (1969) finding that semantic encoding (encoding semantic features as opposed to encoding orthographical features) results in better memory (for a review, Watkins, 2002), was expanded to a broader dichotomy between semantic and non-semantic encoding, and has been replicated hundreds of times (Rajaram & Barber, 2008).

The LOP is an important antecedent of the person memory model in the sense that an initial explanation that was advanced for the incongruency effect was partly based on the differential depth of processing of congruent and incongruent information, determined by distinctiveness. Specifically, the better recall of incongruent information was thought to be the result of a deeper encoding of incongruent information, compared to a shallower processing of congruent information. As we will see, this distinctiveness based explanation is unable to account for the entire scope of findings regarding the incongruency effect. Nevertheless, a thorough understanding of LOP approach is need to better understand the initial formalizations of the person memory model.

The LOP original core proposal was “that the memory trace can be understood as a byproduct of perceptual analysis and that trace persistence is a positive function of the depth to which the stimulus has been analyzed” (Craik & Lockhart, 1972, p. 671). Furthermore, “retention is a function of depth, and various factors, such as the amount of attention devoted to a stimulus, its compatibility with the analyzing structures, and the processing time available, will determine the depth to which it is processed” (Craik & Lockhart, 1972, p.

676). According to the LOP original proposal, “depth of analysis” refers to basic perceptual processes, varying in a continuum from superficial representations to the deepest level of semantics (Roediger & Gallo, 2001). Memory was simply a byproduct of perceptual analysis, not an end in itself (Tulving, 2001).

Different types of processing could be induced by asking participants to perform certain tasks during encoding, that result in attention being allocated to different aspects of the to-be-remembered items, and, consequently, to differential memory performance. The experimental manipulation of orienting tasks by Hyde and Jenkins (1969) found that asking participants to rate how pleasant words were, resulted in better memory for the words, than asking participants to count the 'E's in the words, or to make an estimation of the number of letters in each word. This finding holds true despite people being simply asked to rate pleasantness, count 'E's or letters, or, additionally, they are also asked to remember the information. It was not the intention to remembered that drove the results but, instead, the nature of the processing. It was argued that the pleasantness ratings were the only task that considered the words as semantically meaningful units, resulting in better memory. Interestingly, one contribution of the LOP is the conceptualization of memory as a by-product of the perception and comprehension processes, without the need to consciously intent to memorize information. Craik and Lockhart (1972) developed a paradigm where they distinguish between three levels of processing for verbal materials. Words (e.g., “YACHT”) could be processed in terms of a shallow visual analysis (question: “word in upper case letters?”), in terms of a phonemic analysis (question: “a word that rhymes with 'hot'?”), or in terms of a deeper semantic analysis (question: “a type of boat?”). By asking participants specific questions, the authors advocate that attention would be directed to a particular level of processing.

This processing metaphor of memory advocates the idea that memory performance is determined by the processing, rather than by the stored memory trace. The work by Craik and Lockhart (1972) was crucial in prompting such a metaphor, having been considered by Roediger (1993), the most successful theory of memory of the past 25 years. In a later consideration over the LOP, its authors suggested that the memory trace would be the place where the outputs of perception and comprehension were recorded and, on a deeper level, semantic processing would result in more durable records (Lockhart & Craik, 1990). This assumption is based on the differentiation between coding nonsemantic elements of an event (like visual or phonetic properties) or, alternatively, coding its (semantic) meaning. When people pay attention to the semantic features, the result is then a deeper processing. This semantic processing leads to better retention of the to-be-remembered information. As such, according to the LOP approach, the role of memory systems in determining memory performance is extremely reduced. It was all about the depth of the coding processes and, as such, memory systems had relatively no impact on memory performance. Consequently, the memory trace was more dependent on its qualitative nature, informed by the encoding processes, than on the place where the trace is stored, as would be assumed by the structural theories.

The LOP explanation for the incongruency effect, as it was originally postulated by Hastie and Kumar (1979), claimed that given the distinctiveness of incongruent items, this information is processed at a deep level, whereas the congruent information would be processed at a shallow level. But, instead of constituting a solution for the incongruency effect puzzle, the LOP explanation based on distinctiveness is, indeed, a non-solution. Even if incongruent and congruent information are processed at distinct levels of depth, what causes such processing differences is unknown. What makes one piece of information to be processed deeper, compared with the other? Instead of providing a compelling explanation, the LOP approach can only emphasize what is still unknown about the incongruency effect.

ii) Modeling the incongruency effect – Take 2: The person memory model(s)

In a time where memory modeling was still largely absent from social psychology, Hastie and Carlston (1980) attempted to specify what a cognitive person memory model should be and do. First, in any given model, it should be possible to decompose the processes (or sub-processes) along the information processing approach, that is, between acquiring, encoding, representing, and retrieving information (Hamilton, 1986; Hastie & Carlston, 1980). At least, a memory model should be able to account for the acquisition, retention, and retrieval of information in memory (Crowder, 1976), further specifying the representation, transformation and processing of the information in these sub-stages. A model must consider, first, the perception of stimuli; second, the encoding of information in the perceiver's cognitive structures; third, that information is processed and transformed; fourth, that information is represented in memory, differently from the actual stimuli; fifth, based on the cognitive representation, the information is used. The perceiver can probe, search the memory structure for the stored information, drawing inferences, making judgments and generating behavior. Outputs reflect the joint contribution of stimuli and the cognitive processes that operate on that information (Hamilton, 1986).

ii.i. Person memory model

The person memory model, introduced by Hastie and Kumar (1979), is an information-processing model that was developed to cope with the cognitive representation of social information, namely personality impressions, in memory. Moreover, the model burst out as an attempt to explain the intriguing incongruency effect. In fact, it triggered an incredible amount of research on memory modeling within social psychology, specifically attempting to account for the incongruency effect (e.g., Almeida, 2007; Crocker, et al., 1983;

Garcia-Marques & Hamilton, 1996; Garcia-Marques, et al., 2002; Hamilton, et al., 1989; Hastie, 1980, 1984, 1988; Jerónimo, 2007; O'Sullivan & Durso, 1984; Srull, 1981; Srull, et al., 1985; Srull & Wyer, 1989; Wyer, Bodenhausen, & Srull, 1984; Wyer & Gordon, 1984; Wyer & Martin, 1986; Wyer & Srull, 1980, 1986). The person memory model provided a simple and elegant account as to the reasons why incongruent information is better recalled.

The model was put forward by Hastie and Kumar (1979), extended by Hastie (1980) and Srull (1981) and later enhanced and reviewed by Srull and Wyer (1989) among many others (Srull, 1981; Srull, et al., 1985; Wyer & Gordon, 1984; Wyer & Srull, 1980, 1986). The joint modeling contribution, coming from this set of proposals that emanated from Hastie and Kumar's (1979) seminal work, resulted in what now constitutes the person memory model(s) that are sometimes simply called the Hastie model (Srull & Wyer, 1980), or more generously the Hastie-Srull model (Srull, 1981). The person memory model was remarkably specific concerning its underlying processes. It specified the processes that take place during encoding, the consequences of such processing for the memory representation, and detailed the retrieval processes involved in recalling information from the person memory structure (Hamilton & Garcia-Marques, 2003).

The initial model advanced by Hastie and Kumar (1979) incorporated ideas from associative network models (Anderson, 1976; Anderson & Bower, 1973; Anderson & Hastie, 1974) with ideas from the depth of processing approach (Craik & Lockhart, 1972; Craik & Tulving, 1975; Lockhart, Craik, & Jacoby, 1976), in an "hybrid" model that bridged these distinct literatures. More specifically, according to the suggested initial formulation, Hastie and Kumar (1979) integrated the notion of depth of processing into an associative memory structure. According to this account, the person memory model adopted the encoding assumptions of the levels of processing analysis into an associative network structure, along with the retrieval assumptions of the network models. This was the major theoretical contribution of Hastie and Kumar (1979) original proposal. The person memory model is, therefore, a network model (Hastie & Kumar, 1979) greatly inspired by John Anderson's HAM theory (Anderson & Bower, 1973). The HAM model, by itself and as originally formulated, was unable to cope with the incongruency effect. This is especially the case when the incongruency effect was found under conditions where the congruent and incongruent information had the same set sizes – a pure expectancy driven effect. On the other hand, the levels of processing account for the incongruency effect, based on processing differences between congruent and incongruent information, was also unable to fully account for the incongruency effect by itself. This was so because there was no reference to the memory structure or representation, nor did it specify the way in which the retrieval processes operate. This led the authors of the initial (1979) person memory model to bond ideas from the memory structure of the HAM model, with ideas from the levels of processing analysis of encoding.

The person memory model is a long-term memory model for social information that has emerged since then, as a prominent memory model for the representation of information about individuals. It is relevant to mention, though, that according to its first formulation, the person memory model was not a straightforward long-term memory model. Partially because Hastie and Kumar (1979) did not use filler tasks in their experiments and, consequently, it was erroneous to interpret their findings in terms of a long-term memory store. Partially due to the fact that the model was reticent regarding strong long-term memory assertions. At the outset, the model (Hastie & Kumar, 1979) predicated that the long-term memory store would process only the conceptual information. Episodic information, on the other hand, would be processed in an associative network in short-term memory. Specific facts about individuals (episodic information) would be processed in short-term memory, resulting in a network of associative links. Notwithstanding his previous remarks, shortly after Hastie (1980) sharply established that the room for the person memory model was long-term memory. As people perceive information, a long-term memory associative network is created to encode all information (Hastie, 1980). This rendition of the person memory model is structurally closer to the HAM theory.

The person memory model can be outlined as follows. When the perceiver receives information about a target person, a comprehension process is triggered. Like words are comprehended and sentences parsed, the flow of behavioral information is segmented and parsed into a long-term conceptual memory store (Hastie, 1980). One of the crucial functions of the comprehension process is to identify unexpected and surprisingly incongruent information. Along with the comprehension process, information is being transformed and encoded in memory. The result of such processes has the form of an abstract propositional network (tree structure) (Anderson, 1977; Anderson & Hastie, 1974; Hastie, 1980). Information is retained in memory and forgetting is assumed to take place by a process in which the associative links in the network become less accessible as more memory structures are encoded (Anderson & Bower, 1973). Information is recalled from the memory structure by a retrieval process that abides by the retrieval conventions of the FRAN and HAM models (Anderson, 1972; Anderson & Bower, 1973).

Representational assumptions

The representational principles of social information in the person memory model were formulated according to the HAM representational assumptions. The person memory is implemented, nonetheless, in a coarser-grain, simplified structure.

First, when participants study information about a target, a mental structure (a network where ideas are nodes and associations among the nodes are associative links) is created in episodic memory. This memory representation about a person has a hierarchical structure with three layers (Hastie & Kumar, 1979). At the highest level of the hierarchical structure is the central node, including features or ideas (e.g., the target's name) about the individual. The central node summarizes the identification of the target. This central node is the entry point in the network. The intermediate level has the organizing principles (e.g., traits). Lastly, the lowest level has the facts and attributes about the target (e.g., behavioral descriptions). The person memory model conceives, therefore, that social information is represented in a layered associative memory structure. Behaviors are categorized in terms of traits and stored accordingly.

Second, relations between the nodes in the memory structure are represented by associative links. The central node is connected to the behavioral information by vertical associative links. The behavioral information is connected among itself by horizontal direct associative links. Third, the associative linkages that are formed during encoding are assumed to fade away with time.

Thus, the model assumes that personality traits – devised as conceptual and abstract information elements – are central features of the person memory structure (Hastie & Kumar, 1979). The literature has since suggested that the categorization of social information describing a target in terms of traits is pervasive social-cognitive research, as indicated by the findings supporting the spontaneity of the processes of trait inference (Todorov & Uleman, 2002, 2003, 2004; Winter & Uleman, 1984), transference (Carlston & Skowronski, 2005, Skowronski, Carlston, Mae, & Crawford, 1998), and its limitations (Jerónimo, 2007; Wigboldus, Dijksterhuis, & van Knippenberg, 2003). Trait categories are assumed to be conceptual elements in the memory structure (Rosenberg & Sedlak, 1972; Schneider, 1973).

In 1980, Hastie augmented the representational and processing assumptions of the person memory model, bringing it closer to the propositional structure of the HAM theory of long-term memory. According to this comprehensive person memory model, information contained in a behavioral episode is encoded and stored in a propositional tree in a HAM network (Hastie, 1980). The elements of the propositional tree are specified in a binary structure, in the fashion of HAM. At the top, there is the total idea of the behavioral event. Each tree is composed by two sub-trees: the contextual sub-tree and the fact sub-tree. Thus, attached to the total idea there is an idea node representing the subject of the behavioral episode, which, in turn, is linked to other nodes representing information about the act (relation and object) and its context (location, time, co-actors, etc.). Each behavioral event can be linked to other behavioral events (Hastie, 1980).

The memory structure people keep in mind would be a large network of behavioral episodes linked by several associative pathways among themselves and the referent node. Any given entry-point in the network would be, therefore, linked to several other behavioral episodes. An important feature of such a memory structure – that will be elaborated in the following section – is that the amount of links emanating from any given behavioral episode is not a constant. Some behavioral episodes will establish links to many other behavioral episodes and some other behavioral episodes will establish only a few, if any, links to other behavioral episodes (Hastie, 1980). This feature of the person memory model was introduced by Hastie (1980) and later heighten by Srul and colleagues (1985), being absent from Hastie and Kumar's (1979) original formulation.

Processing assumptions

The person memory model clearly states a small set of three processing rules that operate on the memory structure to encode and retrieve information about a person in memory (Hastie & Kumar, 1979). The retrieval specifications were implemented, initially, for free recall tasks, and only later on were extended for recognition tasks (Srull, 1981; Srull, et al., 1985; Wyer, Bodenhausen, & Srull, 1984).

For reasons of clarity, we will present the processing rules in three groups: the first two relate to encoding, and the third relates to retrieval. First, the rehearsal encoding processing rules (Rundus & Atkinson, 1970). Second, the levels of processing encoding rules, inspired in the work of Craik and colleagues (Craik & Lockhart, 1972; Lockhart, et al., 1976). Third, the associative network retrieval processing rules, which were inspired by the processing assumptions of the associative network models (Anderson & Bower, 1973).

First, relative to the rehearsal encoding processing rules, Hastie (1980) postulates that the links between behavioral episodes are formed when information about different episodes co-exists in working-memory. This idea of simultaneity is crucial to understand the development of inter-item associative links in the associative network memory structure, as proposed by Hastie and colleagues (Hastie, 1980; Hastie & Kumar, 1979). For an association to emerge, two behavioral episodes need to be "considered, transformed, or compared" concomitantly in short-term/working memory (Hastie, 1980). Two sets of inferences are, then, expected to occur: (a) impression formation inferences and (b) causal reasoning inferences. The (a) impression formation inferential processes are responsible for the development of inter-item associative links between some behavioral episodes, and for the management of the current representation about the person. The (b) causal reasoning inferential processes – i.e., spontaneous attribution activity (Hastie, 1980, 1984, 1988; Hastie, Park, Weber, 1984; Wyer, Bodenhausen, & Srull, 1984) – are triggered by the presence of incongruent information that is unexpected and contradicts a previously existing expectancy about the target's character (Hastie, 1980, 1988). It is this non-fitting nature of incongruent information that demands an effort to conciliate and integrate it with the known information about the target. The attribution reasoning for incongruent information leads to a review of the existing impression, in a search for alternative explanations for the occurrence of such unexpected incongruent information, resulting in the development of inter-associative links between the incongruent piece of information and the behavioral episodes to which it was compared. This means that highly informative behavioral episodes incur in additional processing, being more elaborated and receiving deeper and richer encoding. The more a behavioral episode is expectancy-incongruent, the more it is the focus of causal reasoning, and the more time it is maintained in working memory, promoting the development of more inter-item linkages.

Hence, working memory is the locus of such elaboration rehearsal processes. Since working memory is considerably constrained in terms of processing capacity, it is critical to select which pieces of information remain longer in such a limited capacity processor. This selection is made as a function of the relevance of the information to the emergent impression. Relevant information stays for longer periods in working-memory, as compared to non-relevant information. As such, expectancy-incongruent behavioral episodes tend to stay longer in working-memory. The causal reasoning process, in search for an alternative explanation, will bring other known information about the person into working memory. Whenever two elements of information are simultaneously considered, transformed or compared in working memory, they end up linked in the memory structure representing the target. Since expectancy-congruent information does not elicit such comparisons, it won't develop direct associative links among itself. Congruent information will be associated with incongruent information only if a comparison process was triggered by incongruent information. Expectancy-irrelevant information, given that it does not call for such comparisons, is represented in an isolated way in the memory structure. Therefore, the resultant associative network has more inter-episode links between incongruent information and the remaining information, than between congruent and the other known information. Thus, the probability that any given behavioral episode remains in working-memory is a function of its degree of unexpectedness.

To sum up as regards encoding, the formation of links between behavioral episodes results from maintaining incongruent information longer in working memory, where it will be related to previously stored information that is brought into working memory, to new information that is entering working memory; and from the fact that the non-fitting nature of incongruent information requires an explanation, triggering the comparison process.

Second, in the inceptive ideas discussed by Hastie and Kumar (1979), a great deal of importance was given to the levels of processing encoding rules. According to these rules, firstly, information varies as regards to its degree of informativeness. That is, not all information is equal regardless the context of previously known information. Consequently, some pieces of information can be highly informative, whereas other pieces of information are uninformative. That is, given a general impression (or expectancy), the informativeness refers to the degree in which a behavior is congruent or incongruent to that contextual information. Informative items are describe as “novel”, “unexpected” and “nonredundant” regarding the previously know information (e.g., information presented first; that disconfirms an impression; or that is incongruent with a given expectancy is more informative than information presented later on; that confirms an impression; or that is congruent with an expectancy). Secondly, depending on the level of informativeness, the depth in which a piece of information is processed varies. The more an item is informative, the deeper its processing is. Thirdly, information that is processed deeper is less likely to incur decay and, therefore, less susceptible to interference during the retention period. Fourthly, information that was processed deeper – expectancy-inconsistent – is more easily retrieved. Thus, in a context of an impression formation task where participants are asked to integrate all the available information in a unitary representation of the target person, any given incongruent item with an initial impression will be considered highly informative, ending up receiving more elaboration (Hastie, 1980).

Items that are encoded to a deeper extend will establish more associative links with other pieces of information than items that are processed more superficially (Hastie & Kumar, 1979). For that reason, incongruent items (high in informativeness) will be linked to more items than congruent items (low in informativeness). Furthermore, the search process for a causal explanation for the incongruency will result in an associative network of interitem links between the incongruent information and other known information about the target (Hastie & Kumar, 1979). At the time of retrieval, when a search process is triggered in long-term memory, information that is more deeply elaborated would be more easily available (Hastie, 1980).

It is worth specifying the processing differences in the comparison process in the way it deals with congruent and irrelevant information, relative to incongruent information, and that will impact the development of inter-item associative links. On one hand, expectancy-irrelevant information will be left out of the comparison process triggered by incongruent information (Srull, et al., 1985). This comparison is restricted to congruent and incongruent information. Incongruent items can, as a result, end up associated either to congruent items, or other incongruent ones. On the other hand, given that expectancy-congruent information is not unexpected and that it is easy to integrate into the emergent impression, no such comparison processes with other pieces of information will be triggered.

To sum up, people get involved in comprehension processes to understand social information. This processes result in a long-term memory structure, an associative network. Information that is non-fitting, ends up being linked to other behavioral episodes, when compared to perfectly fitting information. The processes underlying the formation of such linkages have features from rehearsal and levels of processing frameworks of information processing at encoding.

Hastie and colleagues (Hastie, 1980; Hastie & Kumar, 1979) emphasized the importance of the rehearsal processes and the levels of processing framework to better understand the encoding of information in person memory, stating that this encoding leads to the incongruency effect. Rehearsal and levels of processing rules are assumed to be critical at encoding, shaping the way the development of links between behavioral episodes takes place in the memory structure. The idea that links could be established between nodes present at the same hierarchical layer of the memory structure – inter-episodic associative linkages – is one of the key features that clearly distinguishes and extends the person memory model, as proposed by Hastie (1980), from the HAM model (Anderson & Bower, 1973). According to the HAM, propositions are independent elements. Therefore, no differences are postulated between the treatment of congruent and incongruent information. Direct associations would not be developed between congruent and incongruent information. Thus, the person memory model put forward by Hastie (1980) was of utmost importance to contribute to the understanding of the incongruency effect.

Third, and finally, in terms of the associative network retrieval rules (Hastie & Kumar, 1979), the person memory models closely follow the retrieval principles of the FRAN (Anderson, 1972; Anderson & Bower, 1973). Retrieval is assumed to take place following the associative pathways connecting the information represented in the long-term memory structure. Firstly, the search process starts at the entry node – the highest node in the layered structured – and progresses through the network using the associative links in a serial node-by-node search process until it reaches the lowest level node, the behavioral episode. Secondly, there is a review process to access whether that information was recalled before. Thirdly, after reviewing, the search process restarts, again at the entry node according to Hastie and Kumar (1979), or, alternatively, it continues traversing the network using the direct horizontal associative links until the next behavioral episode is retrieved or until an isolated node is retrieved, according to Hastie (1980). Ultimately, the retrieval routine is terminated when people stop looking for further nodes, that is, when the retrieved nodes start to be chronically repeated and no novel nodes are recalled. As specified by Hastie in 1980, the search process can return to the entry node and restart the search all over again from the top hierarchical node. Also, and of most importance, according to Hastie (1980), whenever it is possible, the search process transverses the network using the horizontal direct associative links between nodes. This was an important theoretical advancement from the HAM original retrieval proposal. The HAM assumed that propositions were represented independently from one another, thus, no horizontal direct associative links could be established between nodes (Anderson & Bower, 1973). The person memory model, on the contrary, clearly states the existence and importance of such horizontal direct associations that are used at retrieval, and that lead to the incongruency effect.

When more than one associative link is attached to a node, the likelihood of choosing a particular link as the retrieval path is determined by the total number of links that emanate from that specific node. The greater the number of links starting from a node, the smaller the probability of any given link being used at recall. Thus, the probability of recalling any given node is a function of the pattern of inter-item associative links attached to it. This is a random and blind search process.

Theoretically, the nodes in the memory representation with more associations are the incongruent ones, followed by the congruent and, finally, by the irrelevant ones. As a consequence of this higher associative density, incongruent nodes have a higher probability of being recalled than the other types of information (congruent and irrelevant nodes). It is this higher likelihood of recalling incongruent behavioral episodes that constitutes the incongruency effect. Actually, irrelevant nodes have a smaller probability of being recalled given their isolated nature in the network representation. Whenever an irrelevant node is reached, the process has to be re-started at the entry-top-node (Srull, et al., 1985). When the search (re-)starts at the top node, since expectancies can operate as retrieval cues (Srull, 1981; Srull, et al., 1985), and congruent nodes are more strongly associated with the referent node (Srull & Wyer, 1989), it is more likely that a congruent node is recalled first.

It should be remembered, as noted by Srull and colleagues (Srull, 1981; Srull, et al., 1985), as well as Hamilton and colleagues (Hamilton, et al., 1980a, 1980b), that the representational and processing assumptions described in this section are assumed to take place when people form impressions, and not necessarily when people perceive social information with any other processing goal. Actually, the way in which information is processed and represented in memory during an impression formation task should be understood as an incidental learning task, as opposed to an intentional learning task. A second processing goal – memory – was introduced (Srull, 1981) in the original paradigm (Hastie & Kumar, 1979) has a way to isolate the person memory effects to impression formation. As such, Srull (1981) manipulated the processing goals, having half of the participants forming impressions about the target person and half of the participants memorizing that very same information. Results indicate that the incongruency effect was restricted to the impression formation processing goals and, therefore, that impression formation involves processes of information integration into an overall impression.

ii.ii. Twofold retrieval by associative pathways (TRAP) model

The person memory model emphasized the encoding and representational steps of the information processing paradigm, making the case that congruent and incongruent information were represented differently in person impressions. That is, the incongruency effect was a consequence of the encoding processes. Retrieval wise, the person memory model assumed a single invariant retrieval strategy. That is, the memory structure was accessed and probed in a unique way, by traversing the inter-item links in the associative network structure. The TRAP model (Garcia-Marques & Hamilton, 1996; Garcia-Marques, et al., 2002; Hamilton & Garcia-Marques, 2003) challenged such an idea introducing a second recall strategy people can use to retrieve information from memory, besides traversing the associative network from item to item. As such, (i) resembling the invariant recall strategy of the person memory model (Hastie, 1980) and others (Srull, 1981; Wyer & Gordon, 1984), there is the exhaustive recall strategy that can be characterized as being thorough, effortful, resource demanding, systematic, non-efficient, direct, slow, and non-selective in content. This is typically the case for tasks like free recall. It is this recall process that is thought to be responsible for the incongruency effect, since horizontal inter-item associations are always connected to an incongruent item, increasing the likelihood to recall an incongruent as compared to a congruent item. Additionally, the new recall strategy (ii), named heuristic retrieval strategy, proposes that memory can be assessed by means of a selective search process based on the degree of fitness between retrieval cues and the stored memory traces in generating a composite memory judgment. This search can be characterized as being selective in content, effortless, efficient, not thorough, fast, indirect, and less resource consuming. This is typically the case for tasks that involve summary statements where the goal is to arrive at a quick and easy assessment of memory, like frequency estimation or trait judgment. It is this retrieval process that is thought to be responsible for the illusory correlation effect, since frequency estimation is influenced by the ease of retrieval of the targeted instances, and since congruent items are more strongly associated to the target node (i.e., are more easily accessible) the retrieval of a few of these instances lead to the conclusion that there are a lot of those instances in memory. That is, there is a higher fit with the stored memory traces that leads to an overestimation of congruent information relative to incongruent information.

Garcia-Marques and colleagues (2002) provided further evidence for the dissociation between the two recall processes and, of greater importance for the present work, better detailed the search process that is thought to be the basis of the incongruency effect – exhaustive retrieval. First, these authors demonstrated that cognitive resources are necessary to establish the network of inter-item associations and, furthermore, cognitive resources are necessary for the exhaustive retrieval strategy. The manipulation of the cognitive resources available at encoding affected elaborative processing. When resources are low, the development of the inter-item associative linkages is hindered. Given that no (extra) inter-item associations were available at retrieval, the incongruency effect disappears, that is, incongruent items were not better recalled than the congruent ones. Moreover, the same pattern of results emerged (i.e., lack of incongruency effect) when cognitive load was present at retrieval. In that case, even when the pattern of inter-item associations was developed at encoding (no load at encoding), if resources were not available at retrieval, then the search process is unable to make use of the retrieval pathways that were built during encoding. This is a strong evidence for the exhaustive nature of the search process that traverses the inter-item pathways at retrieval, using each item as a cue to retrieve the following one, and that is thought to be the basis for the incongruency effect. This exhaustive retrieval search process is thought to be highly dependent on cognitive resources. Second, these authors demonstrated that exhaustive retrieval is systematic and unselective. When participants attempted to recall information with a selective retrieval goal, the incongruency effect vanished. The explanation is that when participants are attempting to retrieve a specific type of information, they will not traverse the network but, instead, selectively look for the items that match the search criteria. This process does not lead to the incongruency effect since it contradicts the systematic and unselective nature of exhaustive retrieval in free recall (note that none of these manipulations affected the heuristic retrieval outputs in frequency estimation).

Much of the empirical support that was gathered to validate the TRAP model (Garcia-

Marques & Hamilton, 1996; Garcia-Marques, et al., 2002) led the authors to draw conclusions about the pervasiveness of the incongruency effect. Although this effect can be considered one of the most replicated and core findings in social psychology, Garcia-Marques and colleagues (Hamilton and Garcia-Marques, 2003) suggest that the conditions in which the incongruency effect occurs are actually rather limited. This idea is in line with previous research that indicated that the incongruency effect did not occur in specific situations (Driscoll & Gingrich, 1997; Hamilton, et al., 1989). Indeed, it seems to be the case that, for the incongruency effect to take place, it is necessary that the information describes a single trait, that full processing capacities are available at encoding and retrieval, and that recall takes place without any content meaning concern (Bargh & Thein, 1985; Driscoll & Gingrich, 1997; Garcia-Marques & Hamilton, 1996; Garcia-Marques, et al., 2002; Hamilton, et al., 1989; Srull. 1981; Srull, et al., 1985). This is, perhaps, the most unlikely and less frequent scenario in which the social perceivers engage in forming impressions.

The TRAP model was, in fact, proposed to integrate two seemingly incompatible and contradictory findings – the incongruency effect and the illusory correlation effect – into a common theoretical framework. According to the model, this apparent discrepancy occurs because there are these different retrieval processes that typically underlie free recall and frequency estimation. Thus, the TRAP model stresses the importance of retrieval processes in the creation of the divergent patterns of outcomes towards consistent or inconsistent biases. The model assumes the encoding and representational assumptions of the person memory associative network model (Hastie, 1980) regarding expectancy-consistent and inconsistent information, extending its retrieval assumptions to incorporate two retrieval modes that can be used to access and retrieve information from the person memory structure. In the present work we are, nonetheless, mostly concerned with the component of model that accounts for the incongruency effect.

The person memory model(s) is the most sophisticated memory model of social information processing, representation and retrieval. It is the model that best accounts for the representation of person information in memory, and it is able to explain the incongruency effect and the role of previous expectancies on the processing and representation of social information.

iii) Modeling the incongruency effect – Take 3: Recent alternatives and complementary proposals

The classical theoretical proposal (Hastie, 1980; Srull, 1981; Srull, et al., 1985; Wyer & Martin, 1986) that we have been reviewing asserts that the incongruency effect results from differences in the degree of encoding (Hastie, 1988). Although the TRAP model assumes the same general encoding assumptions of the original person memory model, it emphasizes the role of retrieval processes in determining the recall advantage of incongruent information. However, a few different theoretical proposals were put forward either as direct (person memory) or indirect (non-person memory) alternatives or complementary accounts for incongruency effect. We will now review, first, the item and relational processing proposal (Coats & Smith, 2006). Second, the encoding flexibility model (Sherman, et al., 1998). Third, the flexible use of source information (Ehrenberg & Klauer, 2005). Fourth, the trait inference inhibition proposal (Jerónimo, 2007). Fifth, the distinction between semantic and episodic memory (Almeida, 2007).

iii.i. Item vs. relational processing

The first alternative account for the incongruency effect is based on the distinction between individual item processing and relational processing. This differentiation in the type of processing was advanced as an explanation for the isolation effect by Hunt and collaborators (Hunt & Einstein, 1981; Hunt & McDaniel, 1993; Hunt & Worthen, 2006; McDaniel & Geraci, 2006). Given a set of items, item-specific (or individual item) processing distinguishes items from one another. That is, item-specific processing refers to the processing of the individual properties, or unique characteristics, of discrete items that are not shared by other items. Contrarly, relational processing emphasizes the common features shared by the items. That is, relational processing refers to the processing of the common dimensions, or fundamental similarities, among the to-be-remembered items. This entails that, in its essence, relational processing is organizational processing (Worthen & Hunt, 2008), resulting in interrelated items in some sort of scheme. The memory benefits of relational processing are a consequence of the specification of a common context where items are embedded. As Klein and collaborators (Klein, et al., 1994) put it, if elaborative processing conducts to the encoding of the item-specific information that highlights distinctiveness of the to-be-remembered items, organizational processing conducts to the encoding of relational information that highlights similarities and connections among the items.

Research shows that memory performance is better for conditions where there is combined encoding (i.e., item-specific and relational encoding), compared to conditions where there is only one type of encoding (Einstein & Hunt, 1980; Hunt & Einstein, 1981). This general framework is suitable for several distinctiveness effects, like the isolation, or von Restorff effect (Schmidt, 2006). According to this perspective, “distinctiveness is the processing of difference in the context of similarity” (Hunt, 2006, p. 22).

The differentiation between elaboration and organization has been applied to several social psychological phenomena (e.g., Klein, Loftus, Kihlstrom, & Aseron, 1989; Meyers-Levy, 1991), namely as an account of the incongruency effect as we will see shortly (Coats &

Smith, 2006). Klein and collaborators (Klein, et al., 1989; Klein, et al., 1994) introduced a technique to access elaborative and organizational processing, based on repeated measures at free recall. Their purpose was to test the role of organization in impression formation. Basically, participants study the stimulus list once, and later they have a series of recall trials. This technique considers item gains and losses, that is, items that were not initially recalled and are recalled in later trials (gains), and items that were initially recalled and that are not recalled in subsequent trials (losses). If there is a positive relation between elaborative encoding and items gains, there is a negative relation between organizational encoding and item losses. As such, elaboration should lead to item gain, that is, the recovery of new items, and organization should prevent item loss, that is, inter-trial forgetting. The item gain-loss procedure considers two dimensions, one representing the relative amount of elaboration and, the other, the relative amount of organization. It is thought that the elaborative processing highlighted item-specific information that, consequently, resulted in emphasis being given to the unique features of individual items, generating idiosyncratic retrieval cues. Given the amount of such cues, they are not all used in the first retrieval attempt and, therefore, they lead to item gains in subsequent recall trials. Contrarily, it is thought that organizational processing highlights relational information that, consequently, results in a retrieval mapping based on a small sub-set of retrieval cues, the category labels. Such a plan is used to reach the category member items, and is stored in memory, being available in each recall trial, thus preventing item loss. As such, the likelihood of a recalled item being recalled in subsequent trials does not diminishes.

This item-specific/relational explanation of the distinctiveness effect (McDaniel & Geraci, 2006), has been extended by Coats and Smith (2006) to account for the incongruency effect. Coats and Smith (2006) divided their analysis between free recall and recognition measures, since item-specific and relational information are thought to contribute differently to each task. Under the scope of the present work, we are only concerned with the incongruency effect at recall. According to Hunt and McDaniel (1993), free recall tasks depend on item-specific and relational information, since relational information generates further information and item-specific information contributes to the discrimination between information from one another. On the other hand, since recognition is a discrimination task, it is mostly dependent on item-specific information. Given that the incongruency effect is stronger when there is a single target and, additionally, when people are forming impressions, Coats and Smith (2006) postulate that these two elements (single target and impression instructions) encourage the encoding of relational information, which results in a interrelated and organized memory representation. Incongruent information benefits dramatically from this relational processing since perceivers attempt to integrate the information in such an organized memory structure. On the other hand, incongruent information is also at odds with most of the information describing the target and, as such, also benefits from item-specific processing. The high level of processing of both relational and item-specific information leads to a recall advantage for incongruent information that is known as the incongruency effect. Memory instructions, on the other hand, discourage the relational processing. The same happens for target groups, which also discourage relational processing. This explanation is, nonetheless, insufficient to cope with the entire scope of the incongruency effect in recall, given the multiple target settings in which the incongruency effect has been obtained.

iii.ii. Encoding flexibility model

The second complementary framework to the person memory model account for the incongruency effect is the work by Sherman and colleagues (1998), on the domain of stereotype efficiency. The encoding flexibility model of stereotype efficiency (Sherman, 2001; Sherman & Frost, 2000; Sherman, et al., 1998), based on the mismatch theory of novel pop out by Johnston and Hawley (1994; von Hippel, Jonides, Hilton, & Narayan, 1993), can only indirectly speak for the incongruency effect (at recall). The model proposes differences in the encoding processes for expectancy-congruent and expectancy-incongruent information. Focusing on stereotype efficiency and attention allocation, the model posits that stereotypes facilitate, in different ways, both the processing of consistent and inconsistent (or expected and unexpected) information, especially when resources are depleted. The model is based on the distinction between two encoding processes, conceptual and perceptual encoding. The conceptual encoding processes have the goal of extracting the meaning, or gist, of episodes or categories. These processes are top-down and meaning-based. The perceptual encoding processes have the goal of encoding features of specific episodes. These processes are bottom-up and data driven (Hamilton & Garcia-Marques, 2003). The model argues that stereotypes are efficient cognitive structures since, on the one hand, they allow the conservation of cognitive resources and, on the other hand, they allow for the effective allocation of cognitive resources. Consistent stereotypical information is easily encoded since it is conceptually fluent and fits with the activated expectancy or stereotypical framework. Consistent information is well comprehended even when resources are sparse. As a consequence of this fluency, resources are not devoted to the encoding of details of consistent information. These resources are saved and more attentional resources are available to be redirected to the detailed and thorough processing of inconsistent information under load, which notwithstanding having high information value for people's cognitive systems, has low conceptual fluency and therefore is difficult to integrate. This additional processing of inconsistent information results in stronger perceptual encoding, that is, perceptual details are extracted to a greater degree. As a consequence, there will be an inconsistency advantage in recognition tasks (cf. Sherman & Frost, 2000), and an increase in the inconsistency effect in comparison with the no-load conditions (cf. Sherman, et al., 1998). This last finding is contrary to the associative network models of person memory, according to which load should decrease or eliminate the inconsistency effect. Sherman and colleagues (1998) suggest, on the other hand, that cognitive load at encoding heightens the advantage for inconsistent information by a process of attention reallocation. When resources are scant, consistent information is favored by conceptual encoding, whereas inconsistent information is favored by attentional allocation and perceptual encoding.

In summing up, stereotypes facilitate the extraction of the gist of stereotype-congruent information by means of the heightened conceptual fluency of congruent information. Resources that are freed are then available for the encoding of other information, namely for the perceptual encoding of stereotype-incongruent information. This efficient nature of stereotypes is particularly tangible when resources are scarce.

The Encoding Flexibility Model presents a compelling explanation for (an) inconsistency effect (in recognition tasks), focusing one processing differences at encoding. Expectancy or stereotype-consistent and inconsistent information are encoded differently and, therefore, the subsequent memory representation will lead to the incongruency effect when information is used from memory. However, such inconsistency effect is different from the typical incongruency effect in free recall that we have been detailing. Actually, the Encoding Flexibility Model account is not applicable to free recall (Sherman & Frost, 2000) and, as such, the incongruency effect in recall is left out of the scope of the model.

iii.iii. Flexible use of source information model

The third complementary approach to the person memory model that accounts for the incongruency effect is the work by Ehrenberg and Klauer (2005). At a moment when the person memory literature was not clear about the differentiation of an item (e.g., behavior) from the source of that item (e.g., the person that performed the behavior), Ehrenberg and Klauer (2005) highlighted the distinction between source and item memory as a critical way to understand the inconsistency effect. In two experiments Ehrenberg and Klauer (2005) investigated the impact of expectancies on person memory with a source-recognition paradigm. Since the vast majority of the literature on the inconsistency effect deals with single target paradigms, and the measures only tap item information, then item memory is typically confounded with source memory. Ehrenberg and Klauer (2005) claim that the existing accounts of the inconsistency effect are not clear on whether the inconsistency effect is due to an (item) memory advantage for inconsistent information, or to the superior memory for the source of item information. The inconsistency effect can, indeed, be due to the superiority of source memory. To empirically distinguish between item and source memory, multiple target paradigms must be used along with measures that tap item and source information concomitantly (cf. Hamilton, et al., 1989). Source information is crucial for the development of a meaningful impression that guides behavior, especially in settings where the perceiver receives information about different target persons. It is not likely that we will remember that someone said that one is extremely stupid, without then knowing who that someone is. The distinction between item information (the comment) and source information (the person who actually made the comment) is, consequently, decisive in understanding impression formation because if expectancies are differently glued to distinct targets, source memory can determine when a piece of information is expectancy consistent or inconsistent. Source information is, hence, a key element in building, applying and revising representations of people, i.e. impressions. Item memory is understood as a precondition for source memory. It is difficult to know that someone did something without knowing that something was done. However, when source memory fails, reconstructive guessing of the source comes into play (Klauer & Wegener, 1998).

The analysis from Ehrenberg and Klauer (2005) disentangled three processing components of the inconsistency effect by means of multinomial modeling: item-memory (memory for a piece of information), source-memory (memory for the association between the piece of information and the target who performed it) and heuristic reconstructive processes (the heuristic bias that affect the attribution of a piece of information to its correct source). These data support the flexible use of source information model that the authors put forward, claiming that source-memory is critical to understanding the inconsistency effect and that it should be assessed independently of item recognition and reconstructive guessing. The model is in line with the ideas that suggests that expectancies, like schemas, or stereotypes, are efficient because they facilitate the processing of consistent information that arrives at the perceivers' mind. The model is also in accordance with the idea that under cognitive load expectancies are more easily activated and have greater influence on the processing of information (Hamilton & Sherman, 1994). However, the model also proposes that load will not always result in bias towards consistent information (Ehrenberg & Klauer, 2005). In fact, information processing under cognitive load can lead biased processing towards inconsistent information (e.g., inconsistent information is processed in greater detail, Sherman, et al., 1998) and savings gained by the efficiency of such a process can be applied to a secondary task (Macrae, Milne, & Bodenhausen, 1994). Ehrenberg and Klauer (2005) show that inconsistent items profit in terms of source memory to the detriment of consistent information. The existing expectancy benefits consistent items and, therefore, consistent items are encoded poorly in terms of source memory. Consequently, expectancies play a crucial role at retrieval since people use reconstructive heuristics to access source information whenever there is no direct available way to do so. That is, when source information is not available at retrieval, expectancies will lead the way in matching items with sources. Expectancies fill the memory gaps with abstract knowledge.

The encoding flexibility model and the flexible use of source information models tackle inconsistency with compelling explanations, although both these research programs do not deal with the typical recall incongruency effect, that is, the recall advantage for incongruent items compared to congruent ones. In both these proposals recall is not measured and, therefore, there is no account of the better memory in free recall measures for incongruent information in relation to congruent information.

iii.iv. Trait inference inhibition model

Fourthly, the alternative theoretical proposal developed by Jerónimo (2007) can be classified within the person memory model, with important additions and modifications. It constitutes, nevertheless, an ingenious account of the incongruency effect. The trait inference inhibition model (Jerónimo, 2007) asserts that trait inferences are not equally, or balanced, drawn for incongruent and congruent information. The claim is, therefore, that during impression formation expectancies play a crucial role in the inferences that are made. The incongruency effect is, thus, driven by processing differences for expectancy-congruent and incongruent information. In brief, the model proposes that when people form impressions, trait inference inhibition takes place for incongruent information. When trait inference inhibition occurs, people will engage in a search for alternative ways to encode incongruent information. It is this search for an alternative encoding possibility that results in incongruent information being better remembered. Two processes are assumed to be responsible for the incongruency effect, the trait inference inhibition, and the search for an alternative encoding.

Jerónimo's trait inference inhibition (2007) proposal derives, firstly, from the observance of the efficiency (easiness, rapidity and spontaneity) and pervasiveness of trait inferences. People do infer traits from observing behaviors performed by others, and frequently these inferences are spontaneous (for a review, see Moskowitz, 2005; Uleman, Newman, & Moskowitz, 1996). If so, the representation of trait information must be accommodated in the impression, or person representation. Secondly, the trait inference inhibition model derives from Asch's original gestalt ideas (1946), where the goal of forming an impression was to get to the gist of a person, characterized by the traits that best describe that person. Finally, and thirdly, Jerónimo's proposal (2007) derives from a groundbreaking finding by Wigboldus and colleagues (Wigboldus, et al., 2003; Wigboldus, Sherman, Franzese, & van Knippenberg, 2004), showing that spontaneous trait inferences can be inhibited, when the trait implied by a given behavior is inconsistent with a previously activated stereotype about the target.

When people form impressions, traits are inferred from behavioral information, and are associated to the target node in the person representation. The existing expectancies about the target play, nevertheless, an important role in the way these inferences are made. If, according to the trait inference inhibition proposal, there is a critical processing difference at encoding for expectancy-congruent and incongruent information, then information is not all equally represented. When people form impressions, trait inferences are obstructed for incongruent information, thus, the corresponding inferred trait is not extracted for incongruent information. Conversely, congruent information can be easily encoded in terms of the inferred traits. It is this difficulty of incongruent information being encoded in terms of the corresponding trait that triggers the search for an alternative encoding. Two possibilities can then take place. On the one hand, when cognitive resources and motivation are available, there will be a less abstract encoding, that involves revising the previously encoded information and the development of the person memory model' well-known and established inter-item associations, which are assumed to facilitate recall. That is, incongruent information is compared with previously encoded and stored information. On the other hand, when resources are scarce, there will be a more abstract encoding of incongruent information.

According to this model, incongruency recall advantage is due to the joint operation of two processes. First, trait inference inhibition is assumed to only take place with incongruent information. This process is assumed to be highly efficient and frequent. Second, the search for an alternative encoding of the information whose trait inference was inhibited, i.e., the incongruent information. It is the possibility of an alternative encoding that results in the development of inter-item associations, which is assumed to be critical for a better recall of incongruent information. This process is assumed to be highly contingent on the available cognitive resources and motivation.

The incongruency effect is, as such, accounted for in a novel and integrative way, bringing together two apparently distinct literatures, the person memory modeling and the spontaneous trait inferences. By bridging knowledge from two different origins, Jerónimo (2007) provides a parsimonious account for the better recall of incongruent information. The trait inference inhibition proposal (Jerónimo, 2007), corresponds to a person memory modeling of spontaneous trait inferences, with special emphasis given to the way expectancies shape the processing of congruent and incongruent information. It should be noted, finally, that important differences exist between the person memory model account for the incongruency effect, and the trait inference inhibition proposal advanced by Jerónimo (2007). Although both models propose that incongruent information will be more densely associated in memory, they differ in the proposed mechanisms that lead to such inter-item density. According to the person memory model, incongruent information posits a threat to the coherence of the impression, which triggers an effortful attribution process to solve the discrepancy. The trait inference inhibition model proposes that, two different processes that jointly contribute to the incongruency effect, one highly efficient, and the other highly contingent on resources. Moreover, the trait inference inhibition proposal relies on basic cognitive processes, which is not the case for the process specific proposal advanced for impression formation.

iii.v. Semantic and episodic memory distinction in the incongruency effect

The last theoretical alternative account for the incongruency effect is the work by Almeida (2007). As Shoben (1984) noted, the distinction between semantic and episodic memory should be pervasive in social psychology. However, few social cognitive models draw on the distinction between these two memory systems. A rare exception in person memory was recently proposed by Almeida (2007). This author argues that the distinction between semantic and episodic memory is crucial to understand the incongruency effect. A list-method direct forgetting paradigm (Bjork & Bjork, 1996) was used to dissociate semantic and episodic processes. This paradigm is known to affect episodic processes (Bjork & Bjork, 2003), while the semantic processes remain unaffected (Anderson & Neely, 1996).

Participants were told that the study was about impression formation. They were provided with the target's occupational background (e.g., childcare professional) and five personality traits, while instructed to form impressions. After a filler task they were presented with 24 behaviors performed by the target divided in two lists. List 1 consisted of 6 congruent and 6 incongruent behavioral descriptions. List 2 was composed by 12 neutral behaviors. After studying list 1, participants were either instructed to memorize or forget list 1, while studying (keep forming impression) list 2. The typical directed forgetting result is the impairment in remembering list 1 when participants are instructed to forget list 1, as compared to the remember conditions. Additionally, remembering of list 2 is facilitated by the forget instructions because proactive interference is inhibited from list 1 to list 2 , as compared to the conditions where participants are instructed to remember list 1. Results show that incongruent behaviors were more prone to the direct forgetting manipulation that typically disrupts episodic memory, whereas congruent behaviors remain largely unaffected by such manipulation. Almeida (2007) proposes then that the incongruency effect is partly a consequence of an episodic encoding advantage for the incongruent behaviors since they have a semantically isolated nature that leads to an impoverished semantic encoding.

This proposal builds on the explanations for the direct forgetting paradigm findings based on two memory failures (Bjork & Bjork, 2003). First, there is an episodic discrimination failure of the items to-be-forgotten. That is, it becomes difficult to discriminate when or when the episode took place. Since incongruent items are unexpected, they incur in additional episodic encoding. Second, there is an episodic forgetting. That is, participants become unable to recollect that the episode actually took place.

1.2.4. Elements of the associative network models

As we have seen so far, although there is variation regarding the level of specificity of any particular implementation of the person memory model, the core underlying representational and processing assumptions are generically the same. Actually, the models are in close vicinity, if not completely overlapping, in respect to the representational principles (Garcia-Marques & Hamilton, 1996; Hastie, 1980; Wyer & Srull, 1989). In fact, the differentiation between the person memory theoretical proposals rely on processing principles (Garcia-Marques & Hamilton, 1996; Hastie, 1980). As such, from the representational perspective, we would like to turn our attention to this representational communality between models and emphasize the elements in which information is stored in such associative network models.

First, the person memory models assume that information is represented in informational units – i.e., nodes – in a layered, hierarchical network structure (Hastie, 1980). There are nodes representing distinct types of information in each of the existing layers.

Therefore, nodes differ not only in the information they represent, but also in the position they take in the memory structure. There are, at least, three types of nodes. Nodes representing target information – *target node* –, representing personality trait information – *trait nodes* –, and representing behavioral information – *behavioral nodes* (Hastie & Kumar, 1979; Wyer & Srull, 1989).

Second, the person memory models postulate that information is associated in the memory structure by links between nodes (Hastie, 1980). As nodes vary in terms of their hierarchical location in the network structure, there are different types of associations within the person memory model framework. There are vertical links between nodes in different hierarchical layers, and horizontal links between nodes within a given layer. Vertical links can be established between a trait node and the target node – *trait-target links* –, between a behavioral node and the target node – *item-target links* –, and between a behavioral node and the trait node – *item-trait links*. Horizontal links can only be established between behavioral nodes – *inter-item links*. It is important to note, however, that associative links are not developed equally across all types of information.

The central and top node of the associative network memory structure is the target node (Hastie, 1980; Hastie & Kumar, 1979). The target node is the central feature of the person memory model in turn of which all information is gathered and organized. The target node occupies the top layer of the memory structure. All information that is stored in memory in the network representing a person is associated to a specific target node that centralizes all the information regarding that person. As such, all other nodes stored in the network representation of the target are vertically associated to the target node. The association is vertical since all the links to the target node imply associations between different hierarchical levels of the memory structure. An impression – cognitive representation of a person – has a single target node. That is, impressions are individualized representations of people.

The low level, episodic nodes of the associative memory structure represent behavioral information (Hastie & Kumar, 1979; Srull & Wyer, 1979). Behavioral episodes that constitute the stimulus material are the items that are represented at the low level nodes in the associative network memory structure. The behavioral nodes occupy the bottom layer of the memory structure. All items – behavioral nodes – are vertically associated to the top target node, as well as vertically associated to the intermediate trait nodes. The model also postulates the possibility of establishing links between low-level nodes.

Some of the person memory models specify the existence of intermediate nodes in the memory structure (Wyer & Srull, 1989), bellow the top high-level target node and above the low-level behavioral nodes. Intermediate nodes occupy, therefore, the middle layer of the memory structure, representing trait information, usually inferred from the behavioral episodes that the perceivers have encountered in life. The trait node represents an abstraction from the behavioral details. In most studies, the stimuli is constituted by behavioral episodes in the form of sentences describing the target's behavior. In a subset of these studies (Jerónimo, 2007; Wigboldus, et al., 2003), the behavioral stimuli includes the trait information as well (e.g., He was so *intelligent* that he won the chess tournament). In these situations, the trait is not inferred from the behavioral description since it is already present in the stimuli. Irrespectively of whether the trait is present or not in the behavioral description, and thus, inferred or not, trait information is represented as an intermediate layer in the memory structure. Trait nodes establish links with the low-level behavioral nodes and the target node. Trait nodes are not associated among themselves, that is, traits establish vertical associations but not horizontal associations.

It should be noted that in an associative network memory structure representing a person – an impression – there is a single target node. Assuming that forgetting does not take place, there are as many trait nodes as the traits implied by the behavioral descriptions, and as many behavioral episodes as the behavioral episodes that were originally presented at the study phase when participants perceived the stimuli. As such, there is a single target node, a few trait nodes and many more behavioral nodes (with the exception of the situation where all behavioral episodes illustrate different traits, in this case there will be the same amount of trait nodes and behavioral nodes).

Nodes vary in terms of their degree of abstractness, or specificity. The low level, episodic behavioral nodes are specific representations of stimuli that were perceived. Thus, behavioral nodes are concrete, episodic informational nodes. In a higher level of abstractness, there are the trait nodes. At the top level, the target node information is represented in an abstract form, attached to the episodic details of the low level nodes.

Finally, nodes are linked by means of two distinct forms of associations. The vertical links, which associate nodes from distinct hierarchical levels, and the horizontal links, which associate nodes in the same layer. All the existing nodes in the network structure have vertical linkages to the target node. That is, all intermediate and low-level nodes are associated with the target node. Regarding horizontal linkages (i.e., associations within a given layer), these are only assumed to be possible at the lowest-level of the network structure. Therefore, horizontal associations can only take place between behavioral nodes. The inter-item associations constitute direct links between behaviors represented in the memory structure.

Moving back to the beginning of the section dedicated to the incongruency effect, what does the reader remember better about the witch that was introduced right at the start? Is it that the witch flies her broom? Is it that the witch bakes poisoned cookies? Or is that the witch, besides all the witchcraft, reads Karl Popper? Well, if the reader remembered the book, that's it, we got a shoddy replication of the incongruency effect.

1.2.5. Summary – *Section (1.2.)*: Person representations, impressions in person memory

In this section we defined an impression as a cognitive representation of a person and we described an effect of utmost importance – the incongruency effect – for the person memory modeling efforts that came after. Several distinct models have been reviewed to represent person impressions in memory and to account for the incongruency effect, focusing on the person memory modeling approach, and its elements.

Summing up, according to the person memory model proposal when information is encoded, expectancy-incongruent information is difficult to integrate and, therefore, triggers a process to attempt to solve this inconsistency. The perceiver engages in an attempt to integrate the incongruent information in the existing impression about the target person. This process of integrating incongruent information involves retrieving information from long-term memory to working memory, resulting in the coexistence of previously encoded information and the incongruent information in working memory. This coexistence working-memory promotes the development of direct associative links between incongruent and previously encoded information. The result of this process is a network with items vertically associated in the target node and with incongruent items horizontally associated with other items, either congruent or incongruent, with which they were compared while coexisting in working memory. Since congruent information is easily integrated in the overall impression, no such horizontal direct links are built between two congruent items. At recall, the associative links formed during encoding are the retrieval pathways that are used to travel through the network. The more associative links are connected to an item, the more likely the item will be recalled. Since incongruent information is more densely associated in memory with other information, incongruent information has a higher probability of being recalled as compared to congruent information which has proportionally fewer associations.

1.3. Summary – *Chapter (1)*: Cognitive Representations of People and Person Memory

The first chapter was an attempt to contextualize and review in detail the social cognitive literature on the representation of information about persons in memory.

The chapter starts with a brief historical overview to contextualize the social cognition contribution to the study of the mental representation of social information. The second part of the first chapter examines in detail the person memory literature. A definition of an impression is provided and the pivotal incongruency effect is discussed, before analyzing the person memory modeling attempts to account for the processes involved in impression formation in general, and the incongruency effect in particular. Two theoretical ideas are discussed in greater detail as the antecedents of the person memory model, namely the human associative memory model and the levels of processing approach. The chapter ends with a description of the representational elements of the person memory model.

2. Serial Position Effects and Order Effects in Social Psychology

In this chapter, we will be addressing the research that has been done, up to this date, concerning serial position and order effects within social psychology. We intend to do so by attending to the research domains in which such effects have been studied, including impression formation and event memory. Most of this research has been restricted to the measurement of order as a dependent variable, i.e., accessing order information at the test phase. This means that order, or the sequentiality of information, has been measured in research programs designed to address other questions, naturally focused on issues beyond the representation and retrieval of order information. However, the study of order can advance further by looking at order as an independent variable. In other words, the study of order can be, and largely has not been, addressed by the additional direct manipulation of order as an independent variable. Research that has looked at order as an independent variable will be named *serial order effects*, that is, primacy and recency effects, referring to an advantage of items in specific positions of a list. Approaching order as an independent variable implies pursuing a research program explicitly designed to study order information representation and retrieval. The present thesis addresses order not only as a dependent variable but, furthermore, as an independent variable, in search for a representational account of order information in person memory.

We will start by addressing serial position and order effects in the domain of impression formation research, organized in judgment and recall effects, and how the early findings open the field for the inception of order in the representation of information about persons in memory. Then, we will discuss the notion of temporality in event memory, as well as the affinities (and dissimilarities) between event memory and person memory. We will end by emphasizing the necessity of order information modeling in the context of person memory.

The goal of the present chapter is to take the reader from the effects to (the lack of) an integrative theoretical representation to account for the phenomena. We will navigate through the findings that are known about serial position and order in social psychology, to reach the conclusion that although widely studied, the phenomenon of order is yet to be accounted for, from the person memory perspective, or level of analysis. This means that, although a lot is known about serial position and order effects, pretty much nothing is known regarding the representation of order information in the person memory structures – i.e., impressions – and the way such representation impacts the use of these cognitive representations.

2.1. Serial position and order effects in the study of impression formation

There are several well-known examples of serial position and order effects in the study of impression formation, some based on recall tasks, some others based on judgment tasks. The documentation of such effects goes back to the dawn of impression formation research. Perhaps the foremost illustration of an order effect is the primacy effect in impression judgments, unveiled by the primary and foundational work of Asch (1946). Other effects, like the recency effect in recall (Anderson & Hubert, 1963), the serial order effect (Anderson & Barrios, 1961; Hendrick & Costantini, 1970) or the distinctive item judgment effect (Hamilton, et al., 1980a), although widely noted, remained absent from contemporary person memory modeling. Although several serial position and order effects – i.e., effects that could well derive from the cognitive memory representation of order information – are extremely well documented in research on impression formation, the memory models that account for impression formation – person memory – still neglect order, namely the representation of order information and the serial order effect in impression formation.

Herein we will briefly review some order effects that are part of the impression formation literature.

With the discovery of the serial position curve, F. E. Nipher (1876, 1878) along with H. Ebbinghaus (1885/1964) were the first authors to put forward the primacy and recency effects. The serial position curve describes the relation between the serial position of an item in a list and the ability to recall it. The serial position curve is used to plot the results of a free recall task (Anderson & Hubert, 1963). The x-axis represents the serial position of the items as they were presented to the participants, whereas the y-axis indicates the probability of recall for each item, averaged across participants. Typically, the serial position curve has a U shape. Items that were at the beginning and at the end of the list, at the study phase, are better remembered than the items in the middle of the list. The primacy effect describes the better recall of items from the beginning of the studied list. The name – primacy – comes from the items that were presented first in the stimulus list. In contrast, the recency effect indicates the better recall of items from the end of the studied sequence. In this case the name – recency – comes from the items that were most recently presented in the stimulus list. Primacy and recency seem to be based on different memory stores. If the primacy effect seems to result from a long-term memory advantage for the first items that are represented, the recency effect seems to be a direct consequence of the working memory buffer.

One important differentiation should be noted, related to whether serial position and order effects are the consequence of judgment or recall tasks. In fact, the relationship between judgment and memory has been the focus of attention in social cognition for quite a long time. One thing is the memory people have for the studied information, another thing is the judgment people make based on such memory. An example of a recall task involving order is to ask participants to recall the information from the study phase, following the order of presentation of the information. An example of a judgment task involving order is to provide participants with the items from the study phase, and ask them to order the items according to the order in which items were presented.

Beyond the initial ideas that looked at the relation between judgment and memory in a straightforward way, where one and the other were directly related (e.g., recalling positive items would imply a positive judgment – Hastie, et al., 1984), research has shown that the relation between memory and judgment is not that simple, or straightforward (Hastie & Park, 1986). Studies (e.g., Anderson & Hubert, 1963) have dissociated impression formation judgments from the recall of information where such judgments were based. To further understand the relationship between memory and judgment, Hastie and Park (1986) developed a theoretical analysis of the process models in the literature, proposing an account of such mixed findings based on the differentiation between memory-based and online judgments (Bassili, 1989; Hastie & Park, 1986). *Memory-based judgments* are judgments built on the information retrieved from long-term memory. First, information is retrieved and, then, it is used to guide the judgment. Differently, *online judgments* are judgments made when relevant information is found. So, in this case judgments are made even before all information is encoded and stored. If memory-based judgments should lead to a direct relationship between memory and judgment, online judgments should not, allowing for indirect, or not straightforward, relationships between memory and judgment. Hastie and Park (1986) classical dissociation of online and memory-based judgments was obtained by asking participants to make a judgment about a target relying on information describing the target. In one condition participants were told that they would have to make the judgment before the information was presented (online judgment). In the other condition, participants were told that they would have to make the judgment only after the presentation of the information (memory-based judgment). Online judgments, compared to memory-based judgments, are assumed to be prevalent, since people organize information whenever information is perceived to reach a coherent impression of a target person.

In the following sections we will detail a few serial position effects in impression formation research that were obtained with judgment and recall tasks. Thus, the following description of the serial position effects is divided between *serial position effects on judgment*, first, and *serial position effects on recall*, second.

2.1.1. Serial position effects on judgment

i) Primacy effect

While arguing for the notion of impressions as more than the sum of the perceived characteristics of the target, Asch (1946) stumbled upon a primacy effect in impression formation judgments. The summation hypothesis suggested that if impressions were a compound that resulted from summing up the effects of discrete characteristics, then an identical set of characteristics should lead to identical overall impressions. Asch (1946) designed a set of studies (Experiments VI, VII and VIII) to test this assumption.

In Experiment VI, for example, two series of trait adjectives were created, series A and B, reversing the order of the adjectives in the list, so that one series (A) starts with high merit qualities (intelligent and industrious), proceeds to mildly poorer qualities (impulsive, critical, stubborn) and ends with a extremely negative quality (envious), whereas in the other series (B) the order is reversed. Participants that studied list A developed impressions that were glazed with positivity, besides the minor negative qualities. Conversely, those that studied list B produced very different impressions – the target was perceived as "problematic", despite the positive qualities. In fact, the merits were unable to hamper the negative glaze. Likewise, the mild qualities that were interpreted in a positive fashion in list A, took a negative color in list B.

Asch (1946) advanced the *direction hypothesis* as the mechanism driving the differences in impression judgments that resulted from list A and B. The first trait adjectives were thought to set up a direction which exerts a continuous effect on the latter traits. From the first trait adjective onwards, “a broad, uncrystallized but directed impression is born” (pp.272, Asch, 1946). All the following pieces of information were perceived in line with the above mentioned direction. Asch (1946) reported, consequently, a primacy effect of the first traits in the guidance of the impression that participants formed about the target. This primacy effect on impression judgments has been extensively replicated within the study of impression formation (Anderson, 1965b, Anderson & Barrios, 1961, Anderson & Hubert, 1963; Luchins, 1957).

According to Asch's (1946) directed impression, the primacy effect in impression judgments is less about the serial or temporal position of the item *per se* but, instead, it relies on the relation of the item with the following items. In fact, the primacy effect in impression judgments could be erased, or even reversed if, for example, the list had an item that stood out as central, despite its position (“warm-cold” effect in Experiment I, Asch, 1946).

2.1.2. Serial position effects on recall

i) Recency effect

The *shifts in attention hypotheses* (or *attention decrement hypothesis*) (Anderson & Hubert, 1963) was advanced as an alternative to the directed impression hypothesis, as an account for the primacy effect in impression judgments. According to Anderson and Hubert (1963), the determinant of primacy was not the emergence of a directed impression from the initial trait adjectives that modified the meaning of the later ones but, rather, the fact that participants paid less attention to the traits at the end of the sequence, in comparison to the traits at the beginning of the list. The end traits would not have their meaning changed but, alternatively, they would contribute with less weight to the overall impression. Hendrick and

Costantini (1970) showed that having participants reading words aloud was sufficient to change a primacy effect in impression judgment into a recency effect.

Anderson and Hubert (1963) used a similar paradigm to Asch (1946), but introduced a concomitant recall task. In two experiments, participants had to study a list of 6 or 8 trait adjectives, give their impression judgments and, in addition to Asch's original paradigm, they had to recall the trait adjectives that were studied. The recall task was introduced to make participants pay attention to the entire set of items. Results show a primacy effect in impression judgments and a recency effect in recall. For the conditions where recall was not present, a replication of Asch's (1946) primacy (or "first impression") effect was obtained. For the conditions where participants where asked to recall the trait adjectives, the primacy effect was reduced and, in one condition, there was a recency effect. The main findings of the "impression order effect" (Anderson & Hubert, 1963) could be synthesized as follows, the standard impression formation task (i.e., impression ratings) led to a primacy effect, while recall led to a recency effect, by making participants attentive to the whole set of items. That is, there was primacy in impression ratings and recency in recall.

The recency effect (Anderson, 1967; Stewart, 1965) in recall was stronger when the lists were bigger (8 items) as compared to when the lists were smaller (6 lists), whereas the relative importance of the primacy effect in impression ratings was considerably greater for the sets of 6 items, compared to the sets of 8 items (Anderson & Hubert, 1963). Additionally, the serial position curve indicated a strong recency effect and a weak primacy effect.

It is important to re-emphasize that Asch's (1946) primacy in impression ratings – the increased influence of the earlier items in a sequence on the later ones – is different from the typical primacy effect in recall – a recall advantage for the first items in the stimulus list, in the sense that one is based on impressions judgments and the other on recall. It is noteworthy to mention, moreover, that it was the inception of recall in impression formation experiments

(Anderson & Hubert, 1963) that introduced the serial position curve in this literature.

ii) Moving forward: Primacy and recency or, the serial position effect in impression formation

Anderson (1973) pointed out that the integration of information in terms of order means that the position of an item in a sequence plays an important role in determining the effect of such an item on the impression. For example: a stimulus in the initial positions can determine an impression judgment (primacy); a stimulus in the final positions can be vivid and fresh in memory, resulting in better recall (recency). Although extensive attention has been devoted to primacy and recency, most experiments were concerned with measuring only net primacy or recency. Actually, the joint measurement of primacy and recency with the same task and measure was largely neglected and, thus, most studies provide no information regarding the shape of the serial position curve. However, it is crucial to know the serial position curve in impression formation to better understand the step-by-step information processing. This is especially the case when impression formation paradigms can, as we have seen, easily conduct to primacy or recency.

In an experiment where primacy and recency were both accessed in a recall task to originate a serial position curve, Anderson (1973) found that the serial position curve showed essentially primacy, with a lack of bowing suggesting that a recency effect was not obtained. That is, participants recalled more items from the beginning of the list, compared to the middle and end of the list. With Anderson's information integration theory in mind, it is important to distinguish between final and continuous, or cumulative, judgments to understand these findings. Final judgments refer to judgments that are made after participants studied all the stimulus information, in a test phase. Final judgments are, generally speaking, what we described as memory-based judgments. These judgments consider all the information that was presented at the study phase. Differently, what Anderson (1973) used was continuous or cumulative judgments, which are judgments that are made throughout the presentation of the stimulus information (what we called online judgments). According to Anderson (1973) and the attention decrement hypothesis, later items have lowered weight in continuous judgments, possibly because the mechanism responsible for the integration of new information is overloaded by the initial information and, therefore, later information is considered to a lesser degree, having less impact.

The research program developed by Anderson and colleagues (Anderson, 1965b, 1967, 1968, 1973, 1996; Anderson & Barrios, 1961; Anderson & Hubert, 1963) was responsible for the introduction of primacy and recency recall effects in impression formation, bringing back the idea of the serial position curve (Anderson, 1973; Hendrick & Costantini, 1970). This research did not detail the specific mechanisms that lead to primacy and recency, as noted by Anderson (1973, 1996). The relative disorder of the literature over primacy and recency reflects, more than anything else, the fact that the primacy and recency effects are sensitive to procedure details, and much of the analysis of past research has not yet cut deep into the underlying representational processes that account for order.

2.1.3. Order effects on judgment

i) Distinctive item effect

In a before-after discrimination task, participants are simply asked to make a judgment about whether items came before or after the middle item in the studied list. The distinctive item effect (Hamilton, et al., 1980a) refers to the ability to discriminate whether (neutral) items in a list were presented, at the study phase, before or after the item in the middle position (Experiments 1 and 2). When the middle item is distinctive (e.g. “Lost his temper and hit the neighbor he was arguing with” or “insulted his secretary without provocation" in a set of neutral items), participants that formed impressions of the target at the study phase make few errors in attributing items to their correct relative position, before or after the middle item. That is, participants that formed impressions studying lists whose middle item was distinctive performed better in the (order) before-after discrimination task (Hamilton, et al., 1980a). This seems to imply that forming impressions facilitate order judgments and, as such, order seems to be represented when people form impressions about persons.

This finding, together with the better recall performance for impression formation participants (Hamilton, et al., 1980a), supports the notion of impression formation as a process of continuous information integration in some structural organization. Associations are developed amongst the stimulus items and those associations facilitate the later recall of information from memory, as well as the before-after discrimination task (Hamilton, et al., 1980a).

It should be noted that, before Hamilton and colleagues (1980a, 1980b), impression formation research attended only to position effects (either primacy and/or recency). The distinctive item effect, and the before-after discrimination task, constituted the inception of order as a fundamental element to better understand the way we form impressions and organize the information in the person memory structure. We have witnessed a progress from descriptive serial position effects, to the conceptualization of order as an element to understand person impressions. Nevertheless, the theoretical representation of order information in memory is still lacking.

2.1.4. Summary – *Section (2.1.)*: Serial position effects in the study of impression formation

In this brief section we reviewed the serial position and order effects in social psychology. Such analysis was made distinguishing between the conceptualization of order as a dependent variable and order as an independent variable. Also, serial position and order effects were differentiated between judgment and recall effects. Specifically, we reviewed the primacy effect on judgment, the recency effect on recall and the distinctive item effect on judgment. Although several effects are well established and known, the theoretical accounts available for them are rather sparse. At the person memory level of analysis little is known and no specific or direct theory addresses the problem of memory for order information.

2.2. Event Memory: The case of temporality in Social Memory, or An Approach to Memory for Order in the Representation of Social Information

Most of person memory research described in the first chapter deals with presenting participants with one-sentence behavioral descriptions performed by a target person. These behavioral items are “shadows of the complex social events that people often encounter in their daily lives” (Wyer & Carlston, 1994, p. 76). According to Wyer and Carlston (1994), although useful, these one-liners cannot be illustrative of the complexity of social situations in which perceivers acquire knowledge about the social world. In fact, not only are perceivers indirect or direct participants in most daily social events they attend, but also the plenitude of a real event cannot be summarized into a one-liner behavioral descriptions. These two aspects of social information processing (active perceiver and complexity of the social world) have been absent from person memory research. This is the general claim for a research enterprise – event memory – that emerged from the basic person memory research tradition, in search for meaningful memory accounts for complex social information processing. At the fundamental level, these two approaches are complementary, both referring to the representation of actions, where in one actions are performed by a specific person (person memory), in the other the actions are part of a line of causality in an event (event memory). After all, both approaches use the same general methods and are informed and inspired by the same general theories as research in person memory, namely by the associationist principles of memory. They vary, though, in terms of the specificity of the research focus, the question they attempt to answer, the ecological validity of its conclusions, and, the models derived to account for the social phenomena under scrutiny. Indeed, authors of the event memory literature argue that the importance of event representations is undeniable in the processing of social information. Moreover, it is argued that event representation is a core aspect of the impressions people have about persons (Carlston, 1992). It is, as such, surprising that so little has been done to better understand (social) event representation and its use in the domain of impression formation.

Under such analysis, person memory refers to the memory of person information, usually under the form of behavioral descriptions. Person memory can be understood, therefore, as the study of the encoding, representation and retrieval of information describing a person in memory. That is, person memory is concerned with the mental representation of actions about a person. Complementary, event memory is concerned with the mental representation of actions that are causally related in an event. Event memory refers, thus, to the memory of event information, usually under the form of more complex event descriptions. Event memory can be understood, therefore, as the study of the encoding, representation and retrieval of information describing events from memory. Person and event memory are, therefore, complementary approaches to the study of the representation of social information.

Event memory is distinguishable from person memory or, putting it differently, the representation of events is distinguishable from the representation of persons, in the sense that if the first is schematic, the latter is categorical (Wyer & Carlston, 1994; but also, Barsalou & Sewell, 1985). According to Wyer and Carlston (1994) there is no temporal, spatial or causal relation between the elements in the person representation, whereas in event memory there is. For example, as defended by these authors, from the person memory perspective, describing someone as “intelligent, impulsive, and envious”, and “envious, impulsive, and intelligent” makes the exact same sense. However, quite differently, and still according to these authors, from the event memory standpoint, describing a event as “goes for a bike ride, gets dressed, and wakes up” definitely makes less sense than “wakes up, gets dressed, and goes for a bike ride”. This conceptualization is, nevertheless, at odds with the order findings previously described. Specifically, the primacy effect in impression judgments obtained by Asch (1946) showed that the simple manipulation of the order of adjectives in the study list (e.g., intelligent, industrious, impulsive, critical, stubborn, and envious; *or* envious, stubborn, critical, impulsive, industrious, and intelligent) resulted in dramatically different impression judgments, one generally positive and the other generally negative. As such, the rationale presented by Wyer and Carlston (1994) to argue for the importance of order in event memory, but not in person memory is frail. It is true, though, that the inherent causality that exists in event memory is not a necessary condition for person memory. Still, in person memory research, ambiguous information is usually tinted by the previously known information, receiving the general valence of previously perceived information. An ambiguous behavior can be considered intelligent, or stupid, depending on the expectancy people have about the target, or even the previously perceived behaviors. In fact, the role of expectancies in person perception indicates the importance of previously known information in shaping the perception of novel information. Despite the fact that person memory usually deals with information where there is no causal relation between the elements, still, causal (or proxy-causal) relations can emerge from the nature of the information and the way incoming information is related with the other known information.

2.2.1. Event memory and memory for sequences

Research on the temporal aspects of event memory was inspired by a number of different research traditions. The chunking approach to the encoding of sequences of behaviors (Newston, 1976), the story understanding approach (Mandler & Johnson, 1977), the prose comprehension approach (Bransford & Johnson, 1972), and the role of social information scripts (Schank & Abelson, 1977). According to a recent theoretical proposal accounting for the mental representation of event sequences (situation model, Wyer & Radvansky, 1999), when people read event descriptions, it is likely that they will build a mental simulation of the perceived events. The simulation content can, nevertheless, be different from the event content, so that some features of the actual event are not added and some features that did not take place may be added (Wyer & Radvansky, 1999; Colcombe & Wyer, 2002).

Event memory, as person memory, can describe different levels of abstractness, like events involving people in specific (nonprototypic) situations, or prototypic events like eating at a restaurant. Prototypical event representations are thought to be hierarchical sequences of temporally related frames, that is, schemas (Abelson, 1981). In principle, eating at a restaurant involves "entering", "ordering", "eating", and "paying" in this specific sequence, and not in any other. The extent to which prototypical events influence the representation of new events in memory is dependent on the similarity between the prototype and the newly experienced event. Life events differ dramatically and, therefore, there is variability in how alike life events and prototypical events are. In any case, to develop a general account for event memory and the role it plays in social information processing it is necessary to take into account the previously known information. For the representation of sequences of behavioral descriptions, there are two possible event memory conceptualizations. First, when perceivers observe a continuous sequence of behaviors, they extract static frames between breakpoints that constitute transitions between distinct conceptual meanings. It is the memory for the breakpoints that allows for the sequence reconstruction (Newston, 1973). The greater the detail in which a sequence is perceived, the greater the number of breakpoints that was successfully represented. Second, when perceivers observe a continuous sequence of behaviors, they can, alternatively, extract frames at intermediate locations in sequences. According to this perspective, each event sequence would be represented by a single frame (Ebbesen, 1980).

The information about previous events people have represented in memory, either prototypical or non-prototypical, can inform the comprehension and subsequent representation of new information in three different ways. Firstly, previously encoded event representations can be used to infer further events that go beyond the events that have occurred in the described sequence. Indeed, previously known information can fill the gaps and represent the missing events, inferring them from the previously represented events. Pennington and Hastie (1988) asked participants to perform a recognition test after they heard a courtroom testimony and reached a verdict. Participants were more likely to recognize intrusive events when they support their verdict, which suggests that people access the event representation to know whether an item is new or old. Secondly, previously represented events can be used to infer characteristics about the person involved in the events, that is, for impression formation purposes. Carlston and Skowronski (1988) showed that participants use prototypical event representations to draw inferences about a person. Thirdly, and particularly important to the present thesis, if events are not described in a temporal sequence, previously represented event information can be used for order reconstruction purposes.

Indeed, sometimes people learn about events in an order that does not correspond to the actual order in which the events took place. In these cases, order can be reconstructed based on previously known information, namely event information. The activated event must, in some way, match the novel situation to be suitable for being used for the reconstruction of order. This line of reasoning was tested by two independent research programs (Pennington & Hastie, 1988, 1992; Read, Druian, & Miller, 1989).

When people read that “John and Mary drove back to the apartment”, “John gave Mary the money”, “They left the apartment”, “John and Mary made love”, and “John picked Mary up on the corner near the drugstore”, according to Read and colleagues (1989) at least one of two different meaningful sequences can be built. In one, the event described involves a couple buying condoms before making love. The other, involves an interaction with a prostitute. So, according to the first possibility, John gives Mary the money, they leave the apartment, John picks Mary in the corner of the drugstore, they drive back to the apartment and finally they make love. Whereas in the second, first John picks up Mary, then drives back to the apartment, pays her, they make love and, finally, they leave the apartment. The reconstruction of order in such sequences depends then on the previous knowledge people have about the world, that is, previous event representation, as well as specific information people may have about John. In fact, the information about the person can be a key element to interpret the event, and vice-versa. If people have the expectancy that John is a nice and respectable person, than the event should be more likely to be interpreted as a couple buying condoms. However, if people have the expectancy that John is not such a nice person, then the event should be interpreted as an interaction with a prostitute. This illustrates that the representation of the event can be influenced by the personality judgments and, furthermore, personality judgments can be greatly based on the event representation (Asch & Zukier, 1984). Person and event memory are, indeed, interacting. Moreover, a number of different situational factors, for example, the stereotypical groups to which actors belong, can contribute to determine which scenario is used.

In a trial, the order in which the events under analysis actually took place is extremely important to assess whether someone is innocent or guilty. However, frequently, events are learned out of sequence, with no relation whatsoever to the chronological order in which things took place. Interestingly, and surprisingly as well, juror's decisions may be dependent on how the information is reported. This is another example of the use of previously known information to order events. Pennington and Hastie (1988) demonstrated that the ease in which participants can build an orderly and meaningful representation of the events determines people's judgments, as well as their confidence in the judgments. In a similar vein, participants were presented with a testimony that was either organized in a chronological way, or by type of evidence. Results suggest that chronological order of the evidence was crucial, for instance, in overcoming the testimony of a witness (Pennington & Hastie, 1992).

i) Prototypical events (and order)

So, what is the role of prototypic event sequences in the representation of new events? The fact that people are able to use prototypic schemas to represent new events seems obvious. People rely on similar existing experiences to help in the processing of new event information. The question is then, what aspects of the prototypical event are stored with the episodic representation of the event? There are, at least, four possibilities (Wyer & Carlston, 1994). First, according to the *complete copy hypothesis* (Graesser & Nakamura, 1982), whenever a prototypic schema is activated, people can use all the schema components to encode the newly perceived event information. This means that even those components of the prototypic schema that did not take place in the newly experienced event would be part of the event representation. Second, according to the *partial copy hypothesis*, only the components of the prototypic schema that match the experienced event are encoded along with the event representation. Third, according to the *no copy hypothesis* (Graesser, Gordon, & Sawyer, 1979), there is no storage of any component of the prototypic schema but, instead, only a reference pointer to the schema is preserved. Finally, according to the *selective copy hypothesis* (Trafimow & Wyer, 1993), and similarly to the partial copy hypothesis, prototypic schema components are only stored if they are necessary to localize schema unrelated event elements that took place. All these four hypotheses assume that new information is interpreted using previously known information (i.e., prototypical event schemas).

Trafimow and Wyer (1993), and Colcombe and Wyer (2002) analyzed the role of prototypes in event memory. Trafimow and Wyer (1993) demonstrated that when participants use a prototypical schema (e.g., eating at a restaurant) to understand new information, unrelated events facilitate the recall of the prototypical events. However, when participants do not use the prototypical schema while studying the new event, unrelated events interfere with the recall of prototypical events. Colcombe and Wyer (2002) showed, furthermore, that the formation and use of prototypical schemas increased with the amount of exemplars to which the person has been exposed to. An interesting finding by Colcombe and Wyer (2002) is that when the event was performed by the participants themselves, than the prototypes are not used, even if they perform such a sequence of behavior in a daily basis, and when the prototypical schema is represented in memory.

ii) Nonprototypical events and order

Like prototypical events' schemas, or sequences, can be used to interpret new event information, so can nonprototypic events. The role of nonprototypic events in the representation of new events was addressed by Trafimow and Wyer (1993), and Wyer and Bodenhausen (1985). Trafimow and Wyer (1993) did so by using nonprototypical events in the midst of prototypical events. However, it is possible to have complete sequences of nonprototypical events, where events are not related to one another. Wyer and Bodenhausen (1985) conducted one experiment to understand how processing objectives affect the cognitive representation of nonprototypical event sequences. Participants were presented with nonprototypical events observed by a given person at a cocktail party. There were several event sequences, two of which were target sequences, consisting in four events each. These events varied in the order in which they were described (in chronological order: “getting food”, “being bumped”, “spilling drink”, “being called an idiot”; or, alternatively, in the reversed order: “being called an idiot”, “spilling drink”, “being bumped”, and “getting food”). Participants were instructed to form impressions (or to empathize with the target, or to memorize the information) while reading the story about the cocktail party. Later on, participants were asked to (free) recall the events that were studied before, and then to rank the actions in the order they have been presented. Results reported by Wyer and Bodenhausen (1985) show that participants forming impressions tend to recall the events of each sequence together and in chronological order, despite the order in which they were presented (compared to the empathy and memorization conditions). Additionally, participants recalled events from the most recent sequence before recalling events from the other sequence. Thus, it is assumed that for events within the same theme (i.e., the thematically related events within each sequence) participants reorganized the events in the mental representation reflecting the specific order in which the events were presented at the study phase, in an attempt to comprehend the event. Still, since different sequences were absolutely unrelated among themselves, the sequences were represented in memory independently, following the order in which they were perceived. This is the reason that underlies the recall of the most recent sequence, before the recall of the previous sequence.

Wyer and Bodenhausen (1985) argue, based on these findings, that the events in each sequence were coded and organized in memory in a way that reflects their correct temporal order in the studied episode. The sequences of events, on the other hand, do not seem to have been temporally coded. It should be noted that in Wyer and Bodenhausen's (1985) findings, the event sequences portrayed two different persons and situations, without any relation among themselves. But in many circumstances, events refer to the same person and/or general situation. Wyer and Carlston (1994) suggest that in those cases people should be able to encode events in ways that allow for temporal order reconstruction.

Wyer, Shoben, Fuhrman, & Bodenhausen (1985) presented participants with sequences of events, consisting in 10 specific events involving a target person. These 10 events can be categorized into three general events, which are subordinated to the overarching global event. The three general events are temporally related so that the mental representation of the event sequence allows for the ordering of the three general events. The specific events that are part of each general event could be ordered based on general knowledge about the world. Later on, participants were presented with pairs of events and had to select which event occurred earlier (or later). Wyer and collaborators (1985) looked for the time people took to make these judgments, based on the position of the items in the sequence, the distance between them, and whether they had occurred in the same situation or not. Results seem to suggest that participants divide the sequence in three units, assigning a temporal code to each. Regarding specific events, participants do not seem to assign any temporal codes, since it was possible to order them based on general knowledge. One finding that supports such a notion is that participants took less time to reconstruct temporal order of events from different sequences, compared to within unit event order reconstruction.

ii.i. A model for temporal-order judgments in event memory

Wyer and colleagues (1985) proposed a model to account for temporal-order judgments of events. This model has two sets of assumptions, one regarding how information is encoded and organized in memory, the other concerning how the cognitive representation is used to decide the order of the events it represents. Regarding the encoding and organization of events in memory, it is assumed that when the perceiver learns about a sequence of events, he/she will divide them in conceptual units, each one representing a different period in the sequence of events. Each unit has, then, a temporal code associated with it that indicates the unit relative position to the other units. Each unit has also a descriptive code, representing the concept portrayed by the unit. The model assumes that no further temporal coding is done for the events within each unit. That is, the specific events contained in each unit are not temporally coded. The model proposes, then, that the order of the events is reconstructed based on two different processes. On the one hand, there is the unit temporal code that allows for the order representation at the macroscopical unit level. On the other hand, the order within the unit is computed based on general knowledge about the world, i.e., based on logical or causal relations. Fuhrman and Wyer (1988) postulate that the same core of processes operate for self-event memory, and event memory describing others. Thus, it is assumed that events are stored in temporal coded units without any further temporal codes.

Concerning the use of the representation (in order judgments involving pairs of events), three processes are assumed to operate. First, people identify the unit(s) in which the two events of the pair are contained. Second, people compare the temporal codes of the units involved. If the temporal codes of the units are different, then the order of the events is immediately determined. If, contrarily, the events are part of the same unit, the order of the events is determined using general knowledge from long-term memory. Third, there is the response generation. It is assumed that people take longer to make order judgments for events in the same temporally coded unit, compared to events from different units since in the case of ordering events from different units, people skip the second processing step. Moreover, the farther apart the categories are, the easier it is to make order judgments. These assumptions gathered empirical support in the experiments reported by Wyer and collaborators (1985).

Fuhrman and Wyer (1988) were interested on the nature of the representations that are formed based on personal events, and how these personal event representations are used. Moreover, how previously acquired knowledge, specifically the knowledge that consists of people's personal experiences, affect people's judgments and decisions. They were especially concerned in how these mental representations are used to determine the temporal order of the personal events. Participants had to recall events from two distinct past periods (high school and college). Afterwards, participants saw pairs of events and had to order them according to the temporality in which they occurred. Results show that people take less time to make order judgments when events are from different periods, as compared to same-period events. These results depend on the temporal distance between events. These results are interpreted as bearing support for Wyer and colleagues (1985) model where events are organized into discrete time units, and each unit receives a specific temporal code. Furthermore, Fuhrman and Wyer (1988) show that the temporal coding for events about other people is more detailed than for self-events.

Summing up, this research enterprise constitutes the first attempt to approach memory for everyday social experiences and the role of temporality in such processes. That is, the better understanding of the representation of social events. But the complexity and diversity of life experiences, and the events associated to it, is enormous. For example, life experiences can involve multiple sequences of overlapping events that have no relation. One can be at a restaurant, having dessert at the end of a dining experience, when a discussion about a specific topic bursts out. Events can also take place in extremely long time frames. For example, the events that lead Barack Obama to make the good decision to run for president, in principle span quite a long period of time. Indeed, events can take longer that the usual (short) time span events generally last in most experimental paradigms.

2.2.2. Persons and events: Person memory and Event memory

It could be said that research on the cognitive representation of social information has been central in many social cognition research programs. Yet, the focus has been on a restricted set of topics, its processes and the specific paradigms used. But whenever the focus is too restricted or specific, many important aspects of social information representation are left out, unexplored. The quest for the understanding of the cognitive representation of social information can be divided in different research traditions, sharing the same concern over cognitive underpinnings of the representation of social information in memory, and its subsequent use. The nature of what *social information* actually means is, however, quite diverse across approaches. First, there is the cognitive representation of individual persons in memory (i.e., person memory). This research is mostly based on behavioral and trait information describing a target person (e.g., Hamilton, et al., 1980a, 1980b). Not much research has been done based on information perceived from social interactions. Second, there is the cognitive representation of groups of individuals in memory (i.e., stereotypes) (e.g., Garcia-Marques, Santos, & Mackie, 2006; Santos, 2007). Third, there is the cognitive representation of the self in memory (e.g., Kihlstrom & Klein, 1994). Fourth, there is the representation of social events in memory (e.g., Wyer & Bodenhausen, 1985; Wyer, et al., 1985).

Now, we will briefly compare and contrast what was described as the first and fourth approach, person memory and event memory. Although the idea of temporality has been addressed in event memory, it is still absent from person memory. Person and event memory, as previously enunciated, should be understood as interdependent approaches to memory of social information, bearing on the same associative network representational ideas. However, and before any further progress, it is important to distinguish between events and individual actions that constitute the events, as this is the basis to disentangle event memory from person memory. Actually, as Wyer and Bodenhausen (1985) put it, this distinction is somewhat arbitrary, since actions that are part of an event can be events at a lower, more specific, level. The notion of event is, nonetheless, generally distinguishable from the episodes, behaviors, or actions that comprise it. Thus, the notion of *Event* describes a series of temporally ordered episodes, behaviors, or actions. In an event, no other relation between the elements is necessary, but a temporal relation is required. The notion *Action* describes discrete episodes or behaviors that can be part of an event, or can be absolutely independent from one another. As such, actions do not need to be temporally related. Yet, usually actions within events tend to be temporally and orderly related, but this is a consequence of the notion of event, that is not derived from the notion of action. Event memory deals with events and, as such, actions within events are temporally related. Events can involve a single target, or multiple targets. Person memory, on the other hand, deals with independent actions describing a target person, without the necessity for any causal or order relation.

Social information can be conveyed in distinct levels of relatedness among its elements. From the high order (stories), to the low level (unrelated behavioral descriptions), passing through the intermediate level (social events), there are different ways of conveying social information. Stories are constituted by thematically related events, whose order of occurrence plays a role in the way the relations are built. However, differently from stories, the order of events in daily life tends to happen by chance (at least, this is the case for nonprototypical events). Furthermore, unrelated behavioral descriptions about someone have no order whatsoever. As such, if the representation of daily events is different from stories, to an even greater extent the representation of discrete behaviors is different from stories and events, in the sense that no temporal relation can be extracted from sequences of unrelated behavioral descriptions.

Summing up, the temporal component of event memory is concerned with the way people mentally represent temporally related events in memory. Alternatively, person memory deals with the memory organization of unrelated elements in memory describing a target person in what is called a person impression.

According to Wyer and Carlston (1994), few empirical paradigms are able to integrate event memory and person memory. Although the similarities, overlaps and complementary nature of person memory and event memory seem to suggest that these bodies of theory, research and data will come together. From the theoretical perspective, associative network models seem to be able to account for person and event representations within the same memory structures, and the same set of processing assumptions.

Overall, we have been arguing that event memory and person memory are complementary, representing, however, different levels of analysis, with person memory being more specific, and a lower-level approach to the study of social information representation, compared to event memory. Thus, both the type and the form of the information presented to participants differ in these two research programs. Moreover, the differentiation is not restricted to distinct levels of analysis. In fact, and contrarily to what is argued by Wyer and Carlston (1994), it is not the same to describe someone as “intelligent, industrious, impulsive, critical, stubborn, and envious”, as opposed to “envious, stubborn, critical, impulsive, industrious, and intelligent”, as Asch demonstrated, more than six decades ago. People report dramatically different impressions based on those two lists, which led Asch (1946) to report the already described primacy effect. It seems that there is some order relation being represented when people form impressions within the person memory approach. As such, the study of the temporal relation between events in memory does not seem to drain the need for a research program to further understand the representation and use of social information in person memory, namely, order information in impression formation modeling.

The meaning of actions derives from the dynamic interaction between events and persons. An important consequence of such a view is that person and event memory research traditions should be working closely together for a thorough understanding of social memory.

2.2.3. Summary – *Section (2.2.)*: Event memory, the case of temporality in social memory, or an approach to memory for order in the representation of social information

We reviewed the event memory literature and its study of temporality in social psychology. The model for temporal order judgments in event memory, developed by Wyer and colleagues (1985), suggests that order information is represented at the level of units of events, and not directly between individualized events. According to this event memory proposal, order judgments are only made between events that have some sort of temporal relation in memory.

2.3. Order information in person memory: A crucial element to make sense of the (impression formation) world

2.3.1. The role of order information in making sense of the world (or, is it possible to make sense of the world without order information?)

Memory is an amazing and essential cognitive ability. Without memory, the world would be a(n even) strange(r) place, where human life, as we know it, would be impossible.

Although largely unnoticed, memory is everywhere, all the time – memory is, indeed, ubiquitous. More than any other human constructed concept, memory is what we have closest to omnipresence. This is even more apparent if we take implicit memory into account. But, in the same vein, it is not enough to have memory – meaning to have the phenomenological experience of the memory content – it is necessary to know how the information in memory is organized, namely, what comes first, second, etc., that is, memory for order. Without order, memory is useless.

As we have seen, order is a crucial element to make sense about the world. Memory is extremely important for people daily lives but, to have memory by itself, is not sufficient. It is necessary to have memory for order. For example, and grabbing an example from event memory, when people go for a run in the morning, it is not because we have memory that we are able to run. It is, however, because we have memory that we know where the running shoes are stored. Moreover, it is because we have memory of order that we know that it is recommended to get dressed before starting to run. Similarly, it is not because we have memory that we feel hungry, it is, however, because we have memory that we know where food is stored. Moreover, it is because we have memory for order that we know that before eating a chicken, it is a good idea to remove the feathers. If we think about pretty much any human activity, it seems that it involves memory, and order plays a crucial role. When we attempt to imagine an social actor involved in any given activity without memory, it becomes evident how fundamental this component of cognition is to assure a normal functioning life. At a more basic level, as Asch demonstrated, it seems that the way we build representations of people takes into account the order of the information elements in such memory structure. After all, we all know that it is not the same to be intelligent and then stupid, as the other way around.

Thus, the representation of information in memory, particularly order information, is crucial to make sense of the world. This is partly the reason why since Ebbinghaus (1885/1964) scientists have been so interested and active in investigating memory. Within the social psychological approach, the focus has been on the representation of social information in memory. More specifically, in the framework of the present work, we are especially interested and attentive to the representation of information about persons in memory. When we meet someone, it is because we have memory that we know whether that person was friendly or unfriendly, intelligent or stupid, etc. Furthermore, we claim that it is not enough to represent person information in memory. The representational question of person memory is incompletely answered unless the representation of a specific type of person information is addressed, namely the representation of order information. If it is because we have memory that we know that someone was intelligent, industrious, impulsive, critical, stubborn, and envious. It is because we have memory for the order of the information, that it is absolutely different to know it in that order, or the reverse order. The demonstration of the importance of order for making sense about the social world was introduced by the seminal work of Asch (1946) and his documentation of the primacy effect. People report dramatically different impressions based on the two sequences of the exact same traits presented above.

Our claim is that without accounting for order information, person memory modeling is incomplete in its quest for a comprehensive understanding of person representation in memory.

2.3.2. Order effects vs. The representation of order information: An important distinction and a missing link in person memory

Over the past six decades, our knowledge about impression formation has increased tremendously. Similarly, our knowledge regarding order in impression formation has been growing continuously. We know quite a lot about serial position and order effects in impression formation. However, on the one hand, these effects have not been addressed by the person memory model and, on the other hand, order information, at a more fundamental level, has not been considered in the representational assumptions of such models. Order is present in the backstage of the impression formation literature, since the most pervasive and sophisticated models to account for impression formation have neglected the representation of order information. These are two completely different things that should be torn apart. One refers to the well-known and documented serial position and order effects. The other is the representational quest for order information in memory. How is order information represented in person memory?

i) Order effects

Has we have illustrated in section 2.1., there are several serial position and order effects in social psychology and, more specifically, within the impression formation research tradition. Serial position effects, as primacy (Anderson, 1965b, Anderson & Barrios, 1961, Anderson & Hubert, 1963; Asch, 1946; Luchins, 1957), recency (Anderson, 1967; Anderson & Hubert, 1963; Hendrick & Costantini, 1970; Stewart, 1965), the serial position curve (Anderson, 1973; Crano, 1977; Hendrick & Costantini, 1970), or the (order) distinctive item effect (Hamilton, et al., 1980a) are quite ubiquitous in social psychology. The corresponding memory representation to account for these effects remains, according to our analysis, largely absent from social cognitive research in impression formation and person memory.

As we have argued, there is memory modeling for a specific type of social order information (events, section 2.2.). But, this approach to temporality in the representation of social information, although complementary to person memory, does not exhaust the need to account for order in the scope of the present work, in the sense that order remains absent from person memory.

ii) Order information

A given telephone number as a specific order in which its array of elements has to be arranged to have a specific meaning, or make sense. The information that allows for the knowledge that a given element is preceded and succeeded by other specific elements is order information (see section 3.1. of the following chapter for a thorough understanding of order information and how this information can, and should be, differentiated from item information). This order information, crucial to make sense of the way the elements in a telephone number are organized, is what we claim to be lacking in person memory. We know quite extensively about the way informational nodes and inferred nodes – i.e., item information – are represented in the person memory structure. But memory modeling is not exhausted by item information, there is also order information. And we know practically nothing, or nothing at all, about the way order information is encoded, represented, and accessed in the same person memory structure. And, if order is critical to making sense of the world, generally speaking, it seems to be equally important to make sense of a person. As the array of elements in a telephone number have a specific order to make sense, people's representation of information about a person is likely to be determined by order information.

iii) The representation of order information

We argue that it is a necessity to represent order information, along with item information, within the person memory model framework. If the person memory model is exclusively about the representation of item information, then there is the need to extend it to incorporate the representation of order information. This necessity is inescapable since a person memory structure without the representation of order is, necessarily, incomplete and unable to cope with the complexity of the social world, namely the complexity of impression formation and use, as well as with the known serial position and order effects. The person memory model must be adapted, extended, or improved to account for the modeling of order information.

This representational quest for order information in person memory is the foremost goal of the present work, in its theoretical proposal and experiments.

2.3.3. Summary – *Section (2.3.)*: Order information in person memory, a crucial element to make sense of the (impression formation) world

The idea that we attempted to convey in this last section was that without order information it is difficult to make sense of the world. Order is everywhere and, within social psychology, despite the existence of order effects, the fundamental distinction between order and item information was not yet implemented in the person memory model. As such, no representational account exists for the representation and retrieval of order information in the domain of impression formation and person memory.

2.4. Summary – *Chapter (2)*: Serial Position Effects and Order Effects in Social Psychology

The second chapter, dedicated to serial position and order effects in social psychology, was divided in three parts: the first describing the serial position and order effects in impression formation, the second addressing the event memory proposal over the temporality of events, and the third emphasizing the importance or order as an element without which it is difficult to make sense of the world.

Firstly, serial position and order effects were analyzed looking at order as a dependent and as an independent variable and looking for effects on recall and judgment tasks. Secondly, a model for temporal order judgments in event memory was described, postulating that order judgments can only take place for groups of temporally related events. Thirdly, the chapter ends with a section dedicated to the idea that order information is crucial to a thorough and complete understanding of the world in general, and memory in particular.

3. Memory for Serial Order in Human Memory

The problem of serial order, as pointed in Lashley's (1951) classical paper, is related to how people can deal with sequences of items in the correct order. For example, a sequence of six items can be organized in 720 permutations. A sequence of 9, in 362880. So how do we know that a specific sequence of nine digits (in Portugal), and only one, corresponds to a given telephone number? Memory for serial order is, thus, concerned with the storage and retrieval of order information (Henson, 1996). To master the interpretation of the *Nocturnes* by Chopin, a pianist needs to know a bit more than the notes that exist in the composition. More importantly, the notes need to be produced in the correct sequence. Even that, according to the experts, is not enough.

The literature of memory for serial order is organized around two dimensions. One is the memory store dimension. Models of memory for order information account either for short-term or long-term memory, usually not both, although some models cope with short and long-term memory stores (e.g., TODAM, Lewandowsky & Murdock, 1989). The other is the representational dimension, ranging in the level of specificity/abstractness of the representation. Different models postulate distinct representational assumptions and processes for order information in memory. There are three major ways of representing order information, voiced by three sets of models (Henson, 1998): (a) the specific positional theory, (b) the also specific chaining theory, and (c) the more abstract ordinal theory. It should be noted that these two dimensions are not independent. Highly specific positional models, for instance, are always assumed to be short-term memory models and, as such, only chaining and the more abstract ordinal models can, eventually, assume long-term memory representations.

Another important consideration that should be kept in mind is that most of the research that has been done concerning memory for serial order is interested in short-term memory for temporal order. Short-term memory models of serial order are pervasive and dominant across the literature. Person memory is, however, mostly concerned with the long-term memory representations people have about persons. As such, the study of memory for order information within person memory needs to take a long-term memory approach. Although most of the existing models of memory for serial order account for order information in short-term memory, and only a subset of them is able to cope with memory for order in long-term memory, for the sake of a thorough comprehension we will review the entire literature, spanning from short-term to long-term memory models for order information, naturally emphasizing some of the long-term memory models.

3.1. Types of information in the cognitive mind and general considerations within memory for serial order

Before advancing to the description of the theories of memory for serial order, it is important to define the general concepts used in those theories, and to make a few methodological distinctions. What a theory understands as information and the different types of information assumed to be existent – and that need to be accounted for –, are critical concepts that need to be defined by any given model. Thus, it is crucial to understand the nature of the different types of information postulated by the models of memory for serial order. In this literature, there is quite a substantial variation in the definition of the types of information, since different models assume different types of information. However, there is a common denominator. All models assume the dissociation of item and order information. That is, on the one hand, there is the *item information* and, on the other hand, there is the *order information*. These two types of information are assumed to be fundamentally different and, therefore, different representational and retrieval assumptions are conveyed by any given model for each type of information. Some models go beyond this dualistic information categorization, claiming that a third and distinct type of information is necessary, the *associative information* (Murdock, 1993).

3.1.1. Defining concepts: Types of information

Whenever people need to perform a task that involves ordering, it is necessary to have knowledge about the elements involved in the task and their arrangement (Healy & Bonk, 2008). The elements in the task are the items – *item information*. Their arrangement is the order – *order information*.

i) Item information

Item information refers, therefore, to the element itself. It can be measured by recall and recognition measures. When people perform a typical recall task, discrete informational elements are being accessed and retrieved form memory, and finally written in a sheet of paper, or computer screen. The written items illustrate item information. In a recognition measure, item information is, for example in a new-old discrimination task, what allows people to know that a given element was presented before, at the study phase, or not. This ability to discriminate between a newly presented piece of information and an old element is based on item information, that informs us whether there is a representation for the element or not. If there is a representation, the representation may be accessed and its content retrieved (recall), or used to assert that it is indeed an old-item (recognition). If there is no representation, then its content is not retrieved (recall), or the item is considered new (recognition).

ii) Order information

Order information refers, quite differently, to the information that allows one to know how the elements in a sequence are temporally arranged, or how the elements are sequentially organized in memory. When people are asked to reproduce the studied information in the correct order in which it was perceived, order information is what allows people to know that a given element was presented first, followed by a different one, and so forth. This ability to know what is the temporal relation, or arrangement, between the elements is based on order information. Different models, as we will see in the next section, postulate different ways in which this order information is represented and accessed in memory. It could be that order information is represented by associating each element to the position in which it was presented – as postulated by the positional models; by associating the elements among themselves in a inter-item chain – as advanced by the chaining models; or by ordinal gradients, where each item has a different ordinal value reflecting its correct arrangement in a sequence – as proposed by the ordinal models.

iii) Associative information

Some of the recent chaining models or, more precisely, the associative chaining models (e.g., TODAM, Murdock, 1982, 1983, 1993), assume that apart from item and order information, it is necessary to distinguish a third type of information – associative information. It should be noted that, according to these models, order information is assumed to be represented associatively, by the association of the current item with the prior item, and consequently adding this association to the memory vector (Murdock, 1993). Differently, associative information refers to the representation of the link between pairs of elements in memory, irrespectively of order. That is, irrespectively of whether the items are successively, or sequentially related, or not. As such, the difference between order and associative information relies on the fact that order information is associatively represented by linking successive items and, therefore, needs to be disentangled from other associative information that does not represent order.

This critical differentiation between types of information remains absent from impression formation modeling. Person memory deals only with information, without further specification. Information can describe distinct levels of abstractness but, nevertheless, it always refers to, by default, item information. As such, item information is represented in person memory and it is assumed to be represented in the different layers of the hierarchical memory structure. What about order information? It is true that person memory modeling devotes quite an impressive amount of resources to cope with associative information, namely the way the items are associated in memory, either horizontally, or vertically. However, nothing is known about person memory modeling regarding order information, i.e., the way items are sequentially, or temporally, arranged when people form, keep and use impressions.

The differentiation between item and order information is the standard in memory for serial order, although most models naturally focus in order information, because item representation is accounted for by general memory models. Within person memory, a COMEDIAN guy is still the same as a DEMONIAC guy, since these sequences, although constituted by the same array of letters – that is, item information, the letters (e.g., 'N', 'A', 'M', 'E', etc.) –, can only be differentiated by order information. Thus, order information allows one to distinguish between the COMEDIAN and the DEMONIAC guy. As letters need to appear in a specific order for making sense, and to allow the identification of a given word, social information in the person memory structure must appear in a fixed order to allow for the sense making activity of memory. When talking about a cognitive representation of a person, order means we are able to know what the person did in different moments.

It should be noted that it is possible to talk about order in ordinal terms (without mentioning relational terms – in COMEDIAN, firstly we have 'C', secondly we have 'O', thirdly we have 'M', and so forth), or vice-versa (i.e., in relational terms without mentioning ordinal terms – in COMEDIAN, 'C' comes before 'O' and 'M' comes after 'O', and so forth). Order refers, usually, to this temporal sequence of items. However, in some theoretical contexts, order can actually describe the spatial location of items. This is, indeed, the case for positional models, where more than temporal order, people should refer to spatial order.

3.1.2. Two tasks generally used in memory for serial order

Studies of memory (for serial order) typically involve a study phase followed by a test phase. This approach provides usually a snapshot perspective over the process and it contrasts with the serial learning approach that takes multiple phases to access serial learning over time. Most of the recent research on memory for serial order has been shifting to the assessment of order in immediate (single shot) memory.

According to this perspective, there are two main tasks to study memory for serial order, the serial recall and the serial reconstruction of order (Healy & Bonk, 2008). First, serial recall, that has become an increasingly popular procedure, is frequently contrasted with free recall. Free recall involves asking participants to recall a series of items they have studied in a precedent study phase. Participants are free to do so in any given order. Serial recall tasks are similar to free recall tasks with an important single difference, participants are asked to recall the list in the correct, sequential order. Second, serial reconstruction of order was developed as an attempt to isolate memory for order from item memory. In serial recall it is always necessary to remember item information. That is, for people to recall a correct sequence, it is necessary to remember the items that are included in the sequence. In the serial reconstruction of order, item information is provided to participants. Participants are simply asked to reconstruct the correct sequence of the items. As such, participants need only access order information.

Serial recall allows for the concomitant measurement of item and order memory, avoiding potential between-tasks contamination problems that can be prompted by independent measures of order and item information whenever one measure follows the other. However, this very same characteristic can also constitute an important drawback, given the potential within-task contamination problems. In fact, serial recall taps item and order information in the same task, which means that the consequences of item memory on order memory, or vice-versa, are not controlled for.

Serial reconstruction of order, on the other hand, has an important advantage over serial recall since it allows for the isolated measurement of order information (independently of item information). However, despite this important advantage, serial reconstruction of order is inadequate to test the chaining theory. In the context of an associative network representation, if the entire set of items is presented to participants at the study phase – as it is the case in the serial reconstruction of order task –, then it is not necessary to navigate the network to retrieve items. Therefore, under such conditions, it is difficult to examine the chaining process that is assumed to take place at retrieval.

3.1.3. Two findings widely found in memory for serial order

The set of results that can be found in the literature are divided between the serial position curve (or serial position function) and the analysis of errors in tasks involving serial order. They both contribute with important cues to the better understanding of the underlying cognitive processes of memory for serial order information. First, the serial position curve

(Nipher, 1878; Stigler, 1978), initially described for serial recall, illustrates the total number of correct responses for any given position, usually computed across repetitions of the list, or across different lists. The function reflects a bow shape, with the items at the beginning and at the end of the sequence being better remembered. As described before, the serial position curve illustrates the primacy and recency effects, where primacy refers to the mnesic advantage for initial items, whereas recency reflects the retrieval advantage for items in the final positions of the sequence. The bowing is usually characterized by a substantial larger primacy over recency, and primacy has generally more items than recency. Second, the analysis of errors looks to what happens when an item is retrieved but not correctly placed in terms of order. In serial recall tasks these errors can be differentiated in *omissions* and *substitutions* (Henson, 1996). Omissions occur when an item in a specific position is not reported. Substitutions occur when an item is reported, but in an incorrect position. Substitutions can be categorized in *transpositions* and non-transposition errors, or *intrusions*. Transposition errors involve confusing the position of two items, most often in a pair (e.g., repetitions and associates). Non-transpositions errors, or intrusions, correspond to recalling items that were not presented in the original sequence. The analysis of errors is frequently dissociated in transposition and non-transposition errors. An interesting finding regarding this dissociation of errors is that only transposition errors show bowing in serial position functions, not the non-transposition errors (Bjork & Healy, 1974). Confusion errors are non-transposition errors where an item that was not present in the studied sequence is retrieved and mistaken for the original item. Usually confusion errors are due to some level of similarity between the two items. For instance, items can be similar because they are phonologically alike, because their meaning is identical, etc. Non-transposition errors are also frequently driven by positional similarity, where items in a list are replaced by other items from the same position in a different list (Estes, 1991).

3.1.4. Summary – *Section (3.1.)*: Types of information in the cognitive mind and general considerations within memory for serial order

In this section we disentangled three different types of information, namely item, associative and order information. This differentiation which is pervasive in the memory for serial order literature, is still absent in person memory. Furthermore, we reviewed two different tasks (serial recall and the serial reconstruction of order) that are generally used to access order information. These tasks produce serial position functions and patterns of errors that are used to understand memory for serial order.

3.2. Memory for serial order and long-term memory

3.2.1. Types of memory

As we have just seen, one of the dimensions in turn of which the literature of memory for serial order is organized is the memory store dimension. For quite a long time (James, 1890), researchers have been differentiating among types, aspects or forms of memory. One possible way to dissociate memory is based on the idea of duration of memory. On the one hand there is the immediate retention of recently presented information, and on the other hand there is the (more) permanent, long-lasting retention of information. This was what William James (1890) called the primary and secondary memory. It was with Atkinson and Shiffrin (1968) that this distinction took the form of short-term and long-term memory stores. This tendency to differentiate between the short-term and long-term memory has continued to the present day, gathering joint support from behavioral, neuropsychological and neuroscientific research (Schacter, Wagner, & Buckner, 2000).

Nowadays, the terminology *primary* or *short-term* memory has been largely replaced by *working* memory. According to recent conceptualizations (Mulligan, 2008), the type of memory in which most memory for serial models fit – working memory – has been defined as the memory system that is responsible for short-term storage and, additionally, the system responsible for the manipulation of mental representations (Mullingan, 2008). According to Baddeley's (1986) formalization, it is constituted by three processing components: a phonological loop, a visuospatial sketchpad, and a central executive. Accordingly, the phonological loop deals with verbal (phonological) information; the visuospatial sketchpad deals with visual and spatial information; and the central executive is the coordination mechanism that oversees the operation of the two other components. It is the central executive that is constrained in terms of processing capacity. Recently, Baddeley (2002) introduced a fourth component, the episodic buffer where information is linked in the representation.

Long-term memory is also subject to the differentiation between different types, aspects, or forms. First, based on the retrieval phenomenology, people can be consciously aware of the retrieval process or not. This phenomenological experience is the basis for the differentiation between explicit and implicit memory. If explicit memory refers to the intentional and conscious retrieval of information from memory, implicit memory refers to the unintentional and unconscious retrieval of information from memory. Second, based on the informational content of memory, it is possible to distinguish between episodic and semantic memory. Episodic memory is a long-term memory that refers to specific personal events. This is, according to Tulving (2002), what allows people to mentally travel in time. There is some degree of overlap between episodic and explicit memory, since both are settled in the idea of an intentional and conscious process of retrieving information. Alternatively, semantic memory refers to the depersonalized general knowledge people have about the world, represented in concepts, categories, vocabulary, etc. It is possible to enunciate one further type of memory, the procedural memory that refers to the representation of skilled behaviors (perceptual and motor) and more abstract cognitive skills. It is assumed to be a slow-learning memory system that changes slowly with repeated practice. Usually, this kind of memory is involved in activities such as riding a bike.

As it was just described, there are two distinct stores, the short-term (working) memory store and the long-term memory store. Short-term memory deals with information that is processed in working memory, without reaching a long-term memory representation and storage. For example, when we search for the telephone number of a museum, it is our ability to keep it in working memory (or, alternatively, the fact that we have wrote it down in a post-it) that will allow us to know which number to dial when we actually make the call. If this information is later lost, that is, if we do not preserve such information in memory, then it is assumed that the representation of such information did not entered the long-term memory store. As such, the processing of information in short-term memory is always a precondition, or an antecedent of long-term memory storage.

In the memory for serial order literature, as it will be addressed shortly in this chapter, most models cope with short-term memory, rather than long-term memory, or both. Indeed, not only short-term memory for serial order models are prevalent but, moreover, only a few models of memory for serial order handle with long-term memory representations, and even fewer manage simultaneously short-term and long-term memory stores. However, if we do want to address the issue of order representation in impression formation, we need to do so from a long-term memory perspective, since person memory is concerned with long-lasting representations of persons in memory in the domain of impression formation.

3.2.2. Summary – *Section (3.2.)*: Memory for serial order and long-term memory

In this section we addressed the issue of long-term memory representations, differentiating it from working-memory. Long-term memory was categorized in terms of the phenomenological experience between explicit and implicit memory, and in terms of content between episodic and semantic memory.

3.3. Theories of memory for serial order

As we have seen, an important question regarding memory deals with the way individualized items get together in memory to represent information. Specifically we argue that one type of relational information is critical, the serial order information. Indeed, it seems to be difficult to think about a single cognitive activity involving memory that does not require the compilation of items, and where order is not determinant to making sense of them. The theories of memory for serial order, that have been developed to cope with the underlying memory processes to track order, can be divided, according to the representational and retrieval processes, in three major categories. The positional, chaining and ordinal theories. Also, theories of memory for serial order can be organized temporally, between classical and contemporary theories. Most of the classical theories were developed to deal with the serial learning paradigm, more than memory for serial order recall. It is so because the experimental paradigms used then, provided data in a serial learning fashion, which had to be accounted for. Contemporary theories, on the other hand, were developed to account for serial recall.

We will now advance for a description of each theory, exemplifying each one with a few of the most prominent models that each has advanced to account for memory for serial order information. Regarding the positional theory, we will briefly address the classical positional models, like the positional coding (Box model, Conrad, 1965) and the positional distinctiveness (Murdock, 1960) models, followed by the contemporary positional models, like the (later) Perturbation (Lee & Estes, 1977, 1981), the Articulatory Loop (Burgess &

Hitch, 1992), and the Start-End (Henson, 1998) models. Concerning the chaining theory, the classical associative chaining model (Ebbinghaus, 1885/1964; Crowder, 1968) is described, before we turn the focus on the contemporary chaining models, like the theory of distributed associative memory (TODAM, Murdock, 1982, 1983, 1993) models. Finally, with respect to the ordinal theory, we will briefly describe a set of contemporary ordinal models, like the Shiffrin and Cook (1978) ordinal proposal, the (earlier) Perturbation (Estes, 1972), the Primacy (Page & Norris, 1998), and the OSCAR (Brown, Preece, & Hulme, 2000) models.

3.3.1. Positional theory

The positional theory aggregates several models (Burgess & Hitch, 1992, 1996; Conrad, 1965; Henson, 1998; Lee & Estes, 1977, 1981; Murdock, 1960) whose assumptions fall under the ideas asserting that order information is represented by the association of an item to the position in which the item occurred in the sequence. Order is assumed to be retrieved using the position to reach its corresponding item. The positional theory states, thus, that the processes underlying the representation and retrieval of order information in the memory structure are based on position-item associations.

i) Representation of order information

Order is represented in memory by the establishment of an association between a given item, and its position in the sequence of items. It is assumed, therefore, that positional information is represented in memory along with item information, and that order results from associating the item to the position, in position-item associations. This proposal entails that in a sequence of, for example, 9 items, apart from the representation of the 9 items themselves, it is necessary to represent each of the 9 individual positions. All the 9 positions are represented and associated to the item presented in each specific position. Then, a natural consequence is that, given this assumption of positional representations, positional models are, on the one hand, restricted to short sequences, and on the other hand, restricted to short-term memory. If the representation of the individual positions seems perfectly manageable for short-sequences (like a telephone number) that can be processed in short-term memory, it is highly implausible that people would keep the positional identity of items in large sets of items (lets say, a sequence of 32 items). Additionally, short-term memory has a limited capacity store, unable to cope with such simultaneous amount of information. The memory for serial order positional models are, as such, serial order models for short-term memory that cope with rather small sequences.

ii) Retrieval of order information

The retrieval of order information in any ordering task is assumed to take place by the use of each position as a cue to reach and retrieve the item to which it is associated. Order information is, thus, retrieved based on the position-item associations. When people need to order a sequence of items, they will rely on the existing association between the item and the position. In a serial recall task, people can simply access the first position, and report the item associated to it, then move to the representation of the second position, reporting the item associated to that position, and so forth. Alternatively, it is also possible to assume that firstly people retrieve items, and only later on access order information (the position). These position-item associations are thought to be bidirectional and, thus, there is no reason to assume that serial recall implies accessing first the position (or order) and then the item, or vice versa. For serial reconstruction of order, it is assumed that, since item information is provided, participants use the item to access the positional representation and retrieve order information.

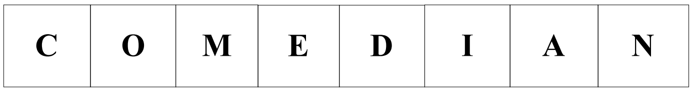
iii) Models

As mentioned at the beginning of this section, models of memory for serial order can be organized in two dimensions (memory store dimension and representational dimension) and, furthermore, can be differentiated in classical and contemporary models. This later classification between classical and contemporary models is based on the experimental tasks that were used at different historical times. First, models were developed to account for the data produced by serial learning paradigms. Later on, the tasks shifted towards the immediate serial recall paradigm, resulting in a large amount of data that was not explicable by the classical theories. Classical positional models were developed to cope with serial learning. We will address the Box model (Conrad, 1965) and Murdock's (1960) positional model.

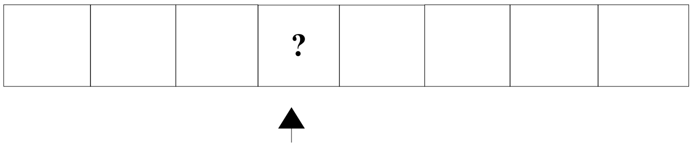
First, the Box model (Conrad, 1965) is a positional coding model for short-term memory. That is, order is represented by the association of the item to its ordinal position in short-term memory. Actually, the general representational and retrieval assumptions just described to characterize the positional models, typically illustrate the positional coding models. In a sequence like COMEDIAN, 'C' would be associated to the first ordinal position, 'O' to the second ordinal position, 'M' to the third, 'E' to the fourth, etc. There would be as many position-item associations as the amount of items (and respective positions). Conrad's Box model (1965) assumed that people had a string of pre-ordered boxes previously represented in memory, and each item would be associated to a specific position, or placed in a specific box, given its position in a sequence. Order would be retrieved stepping through the existing boxes.

When evaluating the quality of a memory for serial order model, two questions are frequently decisive. Firstly, is the model able to cope with repetitions? Secondly, is the model capable of recovering from errors, namely transpositions? Quite impressively, Conrad's (1965) simple model can cope with repeated elements and it is able to recover from errors, two major problems to some of the theories that will be described later. The representation of repeated items in independent boxes assures that the model is prepared to properly represent repetitions. As related with errors, retrieval can progress to the following box even when it is unable to retrieve an item, or when an item is inadequately retrieved. In respect to the transposition errors, there is no reordering of the boxes but, instead, an item can be mistakenly attributed to the wrong box.

The shortcomings of the Box model are, in fact, in its own primary concept, the *box*. If order is represented in boxes, how many boxes are there in short-term memory? If it is assumed that a box is created, or an item is associated to an already existing box for each position, long sequences would imply a great amount of positional boxes in memory. Also, any analysis of errors will show that the most frequent errors occur when items are close together in a sequence, as opposed to items far apart. According to the Box model, positional boxes are independent, therefore, there is no reason to have different outcomes for items in nearby boxes, compared to items in distant boxes.



Representation of order



Retrieval of order

Figure 1: Representation and retrieval of order for a sequence of eight items, COMEDIAN, according to a Positional model – inspired in Conrad's (1965) Box model (adapted from Henson, 1996).

Second, Murdock's (1960) proposal is a positional distinctiveness model. That is, order is represented by the distinctiveness of the positions. Distinctiveness, according to Murdock (1960), is determined by comparing the value of each position, to the value of all the other positions. For example, in a list of eight items, the value of the first position would be the summation of |1 – 2|, |1 – 3|, |1 – 4|, |1 – 5|, |1 – 6|, |1 – 7|, and |1 – 8|, that is 1 + 2 + 3 + 4 + 5 +6 + 7 = 28. And the value of the fifth position would be |5 – 1|, |5 – 2|, |5 – 3|, |5 – 4|, | 5 – 6|, |5 – 7|, and |5 – 8|, that is 4 + 3 + 2 + 1 + 1 + 2 + 3 = 16. Consequently, as specified by the distinctiveness proposal, the first position is more distinctive than the fifth position.

Although rather simple, such model, as most of the positional models, has no problem in dealing with repetitions since there is a discrete position for any given item, irrespective of whether it is repeated or not. Additionally, the model deals with transpositions by simply considering that positions with similar values naturally result in a higher probability of being mistaken.

The contemporary positional models that were devised to deal with the new immediate serial recall paradigm, and that we will describe now, are the (later) Perturbation model (Lee & Estes, 1977, 1981), the Articulatory Loop model (Burgess & Hitch, 1992), and the Start-End model (Henson, 1998).

First, the (later and refined version of the) Perturbation model (Lee & Estes, 1977, 1981) assumes that order is represented by the placement of each item in a three-tier hierarchical structure. A possible illustration involving phonemes, words and sentences goes as follows. Phonemes can be coded in terms of the position within a syllable, in turn, a syllable can be coded relative to its position within a word. Furthermore, a word can be coded in respect to its position within a sentence (Henson, 1996). The hierarchical representation is repeatedly reactivated and a perturbation process runs independently in each level. Consequently, each time there is a reactivation, there is a probability that order information is disturbed. In fact, the Perturbation model assumes that the representation of the positions of item information is perfectly coded, and only during the storage it is assumed that the perturbation process can operate, swapping items. Yet, an important question remains. How is the order of the positional codes themselves, independently of the content items, stored and retrieved from memory? Burgess and Hitch (1996) proposed that positional codes are specific states of internal oscillators, and items are associated with different states of these oscillators. Order is accessed by resetting, or rewinding the oscillator to retrieve sequences from memory.

Second, the Articulatory Loop model (Burgess & Hitch, 1992) is a connectionist network model that specifies a mechanism for serial order retention, along with temporary phonological representations, and an analog of rehearsal that is the phonological loop. Serial order is encoded by the association of an active item to a context signal that contains a subset of the active nodes, and that evolves slowly, changing progressively during the study of the sequence, as depicted in Figure 2. It is like a window moving over time, where successive contextual states are more alike, then states that are temporally distant. Order is retrieved by the repetition of the original contexts signals. The context signal proceeds on the successive items like it did at encoding. Each signal activates the corresponding paired item. In Figure 2, filled circles represent active nodes and unfilled circles represent inactive nodes. The moving window of active nodes, represented by the set of filled nodes, moves from left to right.

● ● ● ○ ○ ○ ○ ○ ○ ○ ○ **C**

○ ● ● ● ○ ○ ○ ○ ○ ○ ○ **O**

○ ○ ● ● ● ○ ○ ○ ○ ○ ○ **M**

○ ○ ○ ● ● ● ○ ○ ○ ○ ○ **E**

○ ○ ○ ○ ● ● ● ○ ○ ○ ○ **D**

○ ○ ○ ○ ○ ● ● ● ○ ○ ○ **I**

○ ○ ○ ○ ○ ○ ● ● ● ○ ○ **A**

○ ○ ○ ○ ○ ○ ○ ● ● ● ○ **N**

Representation of order

○ ○ ○ ○ ● ● ● ○ ○ ○ ○ **?**

Retrieval of order

Figure 2: Representation and retrieval of order for a sequence of eight items, COMEDIAN, according to a Positional model – inspired in Burges and Hitch's (1992) Articulatory Loop model (adapted from Henson, 1996).

Third, the Start-End model (Henson, 1998), as all other positional models, is also a short-term memory model. It proposes that the start and the end of a sequence operate as markers, or anchors, according to which the position of any given item is coded. As such, order is represented as a function of the positional distance in relation to the start and end of a sequence. This positional coding is assumed to take place during each presentation of the item, and subsequent rehearsals, generating an episodic token in short-term memory. Order is retrieved by using the positional (start and end) codes for each position as cues to reach the token that best matches the position.

For each item token, there is a code with two values reflecting the strength of the start and end markers for that position in the sequence. Indeed, the start and the end of a sequence are the most salient portions of nearly all lists, whose distinctiveness should play a role in determining order information. The function that illustrates the strength of the two markers along the sequence of items is assumed to be symmetrically reversed. That is, the start marker is assumed to be strongest at the beginning of the sequence, loosing strength as the positions get progressively distant from the start of the sequence, whereas the end marker is assumed to operate in the reverse fashion, that is, it is strongest at the end of the sequence and weakest at the beginning of a sequence. At the beginning of a sequence, although the end is not yet tangible, people are able to anticipate it, especially when the list length is known. It is this expectation that is assumed to operate as the end marker. The model assumes, furthermore, that the start marker has a greater influence, in comparison to the end marker.

As we just described, according to the Start-End model (Henson, 1998), item representation involves a token representation. Each token codes both the identity of the item and the position of the item in the sequence, where identity represents the content of the item, and the position represents the strength of the start and end markers. An interesting and important distinction between the Start-End model and other positional models is that item tokens are assumed to be unorderly represented in the memory structure. It is at recall that they are, eventually, reordered. Recall operates as a search process for a match between a given position start and end strength values, and the corresponding values represented in item tokens. The item that best matches the position values, is the one retrieved as the item corresponding to that specific position. An item that is retrieved is suppressed and, thus, the likelihood of being recalled for a second time is reduced. This model of memory for serial order emphasizes that order is represented indirectly in memory. Start and end markers' values are represented along with item information. However, order information is only a product of recall.

For the three contemporary serial position models just described, both repetitions and errors, namely transpositions, can be accounted for. For example, according to the Start-End model (Henson, 1998), it is absolutely irrelevant whether an item is repeated or not since, regarding order information, the strength values of the start and end markers are coded for each time an item is perceived at a specific position in a sequence. Regarding errors, namely transpositions, it is assumed that items that are temporally close together have similar values for the start and end markers, resulting in a increased likelihood of being misattributed to an erroneous position.

3.3.2. Chaining theory

Chaining models are among the oldest, as well as the most recent theoretical proposals for memory for serial order information. The first chaining models date back to 1885 and Ebbinghaus' account for serial order. Among the latest, there is the theory of distributed associative memory by Murdock, Lewandowsky and collaborators (Lewandowsky & Li, 1994; Lewandowsky & Murdock, 1989; Murdock, 1982, 1983, 1993). According to the chaining theory, generally speaking, order is represented in memory by the association of successive items. Order is retrieved in a step-by-step chaining process, where each item cues the next item to be retrieved. The chaining theory asserts, thus, that the processes underlying the representation and retrieval of order information in the memory structure are based on inter-item successive associations.

i) Representation of order information

According to the chaining models, instead of order being represented in memory by the association of an item to its position in the sequence, order is represented by the establishment of an association between two successive items. As such, there is no need to assume the additional representation of positional information to code for order information – as posed by the positional modes. Item information, along with the associations between items, is sufficient to represent order information. Order is, thus, a simple association between an antecedent item and its subsequent item. The association records, necessarily, which item precedes and which follows. The chaining theoretical proposal suggests that, for example, in a sequence of 9 items, there will be discrete representations for each item and, also, an association between all the successive pairings, which would mean 8 inter-item chaining associations (the amount of pairwise associations is always N-1, where N is the amount of items in a sequence). According to this chaining assumption, it is not difficult to account for long sequences of items since associations are easily represented in any associative memory structure. This idea is in line with most associationist network models (e.g., Anderson & Bower, 1973). Besides, it is plausible to assume such a representational process in a long-term memory store, not restricted to short-term memory.

ii) Retrieval of order information

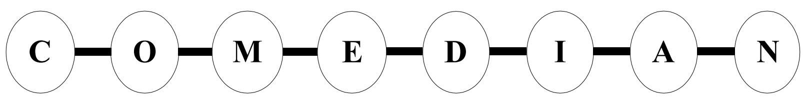
The retrieval of order information in any ordering task, according to the chaining models, is assumed to take place by the use of each item as a cue to reach and retrieve the subsequent item, to which it is associated, in a step-by-step chaining process. Order information is, consequently, retrieved based on inter-item successive associations. When people need to order a sequence of items, they will rely on the existing association between the precedent item and the subsequent item. In a serial recall task, people transverse the inter-item associations in a chaining process, accessing the first item, reporting it, the item then cues the second item, which then cues the third, and so forth and so on. Some models, in an attempt to cope with backwards recall assert that inter-item successive associations are bidirectional. In tasks that involve serial reconstruction of order, item information is provided, so participants just have to isolate each item and look at which other items are cued by the selected item, to retrieve order information.

iii) Models

Along the differentiation of models in terms of classical and contemporary models, we will first briefly describe the classical chaining models, developed to account for serial learning tasks, namely the associative chaining proposals by Crowder (1968) and Ebbinghaus (1885/1964). Regarding the representational processes, classical chaining models can be dissociated in simple (Figure 3) and compound (Figure 4) models, depending on whether only simple or compound chains are assumed to represent order information.

Simple chaining models (Crowder, 1968) postulate that inter-item order associations can only be established between items in successive positions, where one item is associated to the next item in a chain (Figure 3). That is, simple models assume a univocal chain from the start to the end of any given sequence of items. As such, only pairwise associations can take place. In COMEDIAN, 'C' would be associated to 'O', 'O' would be associated to 'M', 'M' would be associated to 'E', and so forth and so on. These models are amongst the simplest proposals to account for memory for serial order.

Simple chaining models for serial order are very limited in their ability to cope with repetitions and errors. When repeated items exist in the stimulus list, one single item will be cueing more than one item, making it impossible to distinguish which of the cued items corresponds to the correct item in the sequence. Even further, simple chaining models have a harder time to account for errors. Namely, according to these models when the chain brakes, there is no way to keep retrieving items and accessing order information. The main criticism faced by (simple) chaining models is that the chain can only be as strong as its weakest link. For example, we know that not remembering a word in the lyrics of a song rarely implies not remembering the subsequent words.

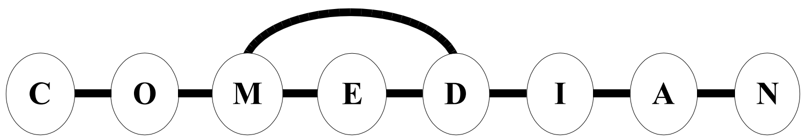


Representation of order

Retrieval of order

Figure 3: Representation and retrieval of order for a sequence of eight items, COMEDIAN, according to a Simple Chaining model – inspired in Crowder (1968) model (adapted from Henson, 1996).

From another perspective, compound models (Figure 4) postulate that, apart from simple successive inter-item direct associations, there are remote associations (Ebbinghaus, 1885/1964). It is usually assumed that direct successive inter-item associations are stronger than remote associations. Part of the above mentioned criticism of the chaining proposals is eliminated since cues can be composed of more than one item, which makes it possible to recover from a break in a sequence, since there are more inter-item associations than the ones assumed by the univocal chaining idea. As such, it is possible to cope with error since contextual associations allow for recovery. Not remembering a word in the lyrics of a song, according to the compound chaining models, does not imply that subsequent words are not remembered.



Representation of order

M E — ?

Retrieval of order

Figure 4: Representation and retrieval of order for a sequence of eight items, COMEDIAN, according to a Compound Chaining model – inspired in Ebbinghaus (1885/1964) chaining model (adapted from Henson, 1996).

Regarding the representational processes, contemporary chaining models, like TODAM (Lewandowsky & Murdock, 1989; Murdock, 1982, 1983, 1993, 1995, 1997), can be considered simple or compound models of memory for serial order depending on whether we refer to the original formulations (Murdock, 1982, 1983), or to the later theoretical developments (Murdock, 1993, 1995). TODAM is the acronym for *theory of distributed associative memory.* It is an associative chaining theory of memory for serial order that, unlike most of the other models of memory for serial order, is also a general memory theory, that also accounts for memory for serial order, as the proposal by Anderson, Bothell, Lebiere, and Matessa (1998). As such, TODAM is a theory of memory for serial order that accounts for both short-term and long-term memory stores.

However, the major difference of TODAM is that representations are distributed, not localized, as in most of the models just described. Information is represented together in a common random memory vector. This holds true for item and order information. Successive items are associated by means of a mathematical operation called convolution, which blends item information together in the common memory vector. As such, the convolution output is added to the memory vector. Order information is thus represented by series of pairwise associations, represented in the common memory vector. Order information is retrieved by another mathematical operation, named correlation that is the reverse of convolution. Such retrieval process entails that a memory probe representing a specific item is correlated with the common memory vector. The result is a vector that approximates the probe with the response item. When correlation produces this approximation to the response item, it triggers a deblurring, or interpretation process before recall. If the deblurring process originates a recall response, the new response vector can be used as a probe for the next item in the sequence. When no response is produced by the deblurring process, the approximate vector that was generated can be used as the probe to recall the subsequent item. As such, TODAM has no problem in overcoming the key problem of the classical chaining models: the chain becomes stronger than its weakest link. Besides, in a later formulation of the TODAM (Murdock, 1995) it is also assumed that associations can take place at a higher, abstract level, between chunks of items. The convolution, correlation and deblurring operations, given the general scope of the model, are the processes by which all information is stored and retrieved from memory. The specificity of memory for serial order is dealt with the assumption that successive items (and chunks of items) get convoluted, correlated and deblurred together in the common memory vector. The original TODAM model (Murdock, 1982, 1983) assumed only pairwise associations. Subsequent developments (Murdock, 1993, 1995, 1997) go beyond pairwise associations, into a compound memory for order formulation. Indeed, in its most comprehensive formulation, TODAM is able to deal with serial learning and serial recall.

One argument against the sufficiency of the chaining theory deals with interference processes. When different sequences of the same elements like Steal, Least, Tales, Slate, Teals, and Stale are stored, almost every letter in these words is associated with every other letter. How can then the correct order be retrieved? One other argument against the chaining theory is related to the fact that order seems to involve more than simple linear temporal structures. As the phonemes in syllables, the syllables in words and words in sentences, order seems to be stored in a hierarchical memory structure where syntactic and schematic rules operate far beyond inter-item associations. Also, chaining models have a hard time explaining the start of the retrieval mechanism. How can the first item in a sequence be retrieved, triggering the chaining process is a process that usually requires additional assumptions.

3.3.3. Ordinal theory

The ordinal theory is the last major category in which models of memory for serial order can be organized. It aggregates several models (Brown et al., 2000; Estes, 1972; Page & Norris, 1998; Shiffrin and Cook, 1978) whose representational and retrieval assumptions suggest that order is represented in a single dimension. Order is then determined by the relative value of the item on the given dimension. Order is retrieved by moving in the dimension in both directions. The ordinal theory asserts, thus, that the processes by which order information is represented and retrieved from memory are not based on position-item associations, nor inter-item associations. Most ordinal models are rather recent and, as such, we will only address contemporary ordinal memory models for serial order, that is, models that were developed to account for serial recall data.

i) Representation of order information

As specified by the ordinal models, order is represented in memory in an indirect fashion. There are no position-item, or item-item associations to represent order. Instead, there is a single dimension and order is represented by the item's relative value in that dimension, which constitutes a more abstract way of representing order information. Healy and Bonk (2008) assert, nevertheless, that ordinal models assume the representation of order by simple associations. However, these associations are different from the position-item, or item-item associations, given that the item is associated with a control element representing the environment in which the list was studied. The association is then built between an item and the ordinal dimension. Ordinal models propose that, for example in a sequence of 9 items, there is a representation for each individual item, and each item has a value for the ordinal/environmental dimension that codes for order information. Ordinal models are, then, especially prone to deal with long-term memory representations since the representational process postulates by this set of models is largely independent from the capacity constraints of short-term memory. Any given item stored in long-term memory can be associated to, or have incorporated in itself, a value coding for order information.

ii) Retrieval of order information

When people need to access order information in any given task involving ordering, people will rely on the value coding for the ordinal dimension to reach and retrieve order information and temporally organize information. The process of accessing order is assumed to move bidirectionally in the ordinal dimension. Therefore, there are no direct associations between items themselves or between items and positions, but only an indirect association between items and a value coding for the ordinal dimension. It can be said, though, that order information is retrieved based on less specific item-ordinal dimension associations. In a serial recall task people access any given item and then report its ordinal value, then recall a different item and report its ordinal content, and so forth and so on. It is assumed that recall is not based on ordinal cues but, instead, recall is independent of order, although order information is always accessible when people have recalled item information and, therefore, when needed, it can be used for ordering purposes. Concerning serial reconstruction of order, it is assumed that, given that item information is provided, people need only to search for the ordinal code within each item to access which item in a sequence came first, second, etc. Ordinal models are the only models of memory for serial order that assume that recall takes place independently of serial order information. That is, recall is based on other meaningful cues (e.g., semantic similarity). Recall can, however, retrieve order information to use it in any task in which order is necessary.

iii) Models

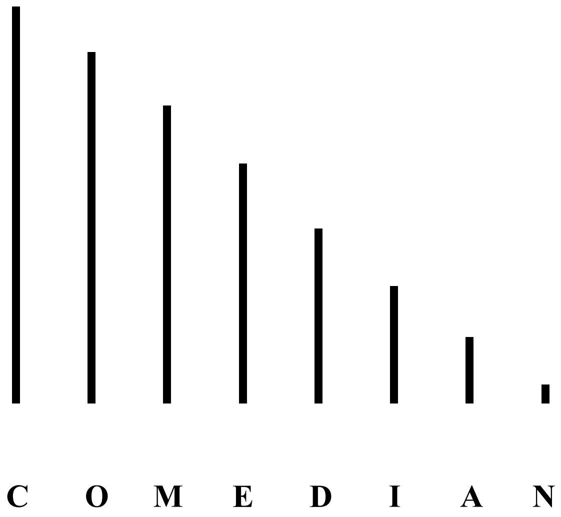
Ordinal models of memory for serial order are among the most recent models to cope with the representation and retrieval of order information. The models that we will address now are the (earlier) Perturbation (Estes, 1972) model, the Shiffrin and Cook (1978) ordinal proposal, and finally the Primacy (Page & Norris, 1998), and OSCAR (Brown, et al., 2000) models. As we will see, ordinal theory escapes most of the criticisms addressed to positional and chaining theories.

First, the original formulation of the Perturbation model (Estes, 1972) is an ordinal model for serial order. Order is coded by the association of all items to a single control element, representing the context in which the sequence was studied. The same control element is linked to items by means of a reverberating loop. The reverberating loop implies that any given item will be reactivated whenever the control element is accessed. Order is given by timing differences in the reactivation of the items, that is, by the cyclic reactivation of items. It is assumed that memory for order is perfectly stored. When people are unable to retrieve order information, either the access to the control element was lost, or there could be perturbation in the proper timing of recurrent reactivations. It is this perturbation process that is assumed to be the cause of erroneous reorderings of items, like transpositions and the symmetrically bowed-shape curve of the serial position curve.

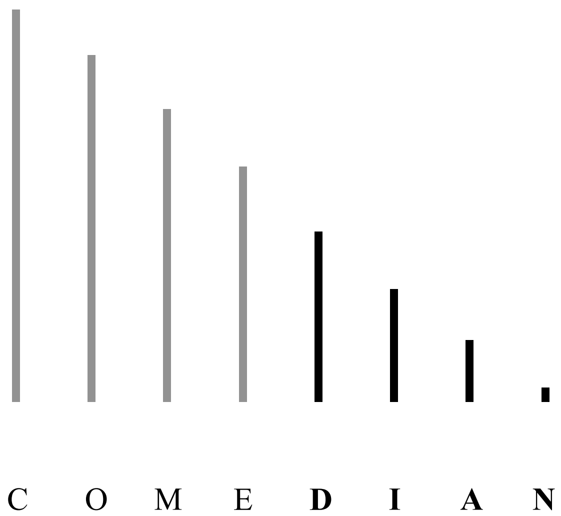
Second, the Shiffrin and Cook (1978) ordinal model proposes that items are associated to nodes, and only nodes are associated among themselves. There are several nodes, namely nodes representing the beginning and the end of the sequence. Order is then indirectly represented by the association of items to nodes. Order is retrieved by moving from the nodes to the items. Item information is then reconstructed based on the associations between the nodes to which items are linked.

Third, the Primacy model (Page & Norris, 1998) shares similarities with the positional Start-End model (Henson, 1998) and the ordinal Perturbation model (Estes, 1972). The Primacy model is a short-term memory model inspired in Grossberg's (1978) idea of a primacy gradient of strength in memory. Order would be stored by each item's value in the primacy gradient, so that items close to the beginning of the sequence would be stronger in the primacy gradient, and this strength would decrease as the sequence progresses. Order would be retrieved by the selection of the strongest item – greatest activation –, followed by its subsequent suppression, again the selection of the following strongest item, its suppression, and so forth and so on. The Primacy model formulates the idea of primacy strength in an association between the item and the context element representing the start of a sequence. The Primacy model does not specify, thus, positional information. Order information is accessed, or derived, at retrieval from the items' relative activation strengths. According to this view, the initial context of the start of a list is like the control element of the Perturbation model (Estes, 1972) and, simultaneously, the start maker of the Start-End model (Henson, 1998).

It is assumed that items' activation decreases exponentially. Consequently, the activation of different items can end up similar and items may be confused at the moment of selecting the strongest one. As such, errors are the consequence of a difficulty in making a proper selection of the actual item with more activation. This model is able to cope with most of the findings in the literature. Obviously, the primacy effect does not pose a problem to the model since items at the beginning of any given sequence enjoy the strongest activation of all the items in the sequence. Alternatively, the recency effect is assumed to be the consequence of a unidirectional transpositional possibility, as compared to the bidirectional transposition errors that can take place for items in the middle positions of the sequence. The model accounts for transpositions that are the result of neighboring activation confusions – paired transpositions. Either the predecessor item is perceived as having more than its actual activation, or the successor is perceived as having less than its real activation strength.



Representation of order



Retrieval of order

Figure 5: Representation and retrieval of order for a sequence of eight items, COMEDIAN, according to an Ordinal model – inspired in Page and Norris' (1996) Primacy model (adapted from Henson, 1996).

Fourth, the OSCAR model (Brown, et al., 2000) is a oscillator-based computational model to account for memory for serial order. Oscillators are, according to the OSCAR, timing mechanisms constantly generating rhythmic outputs. These rhythmic outputs change continuously, occurring at different frequencies. High-frequency oscillators are always repeating, whereas the low-frequency oscillators rarely repeat. Order is represented by the use of the oscillators timing mechanisms. Exactly in as other models, the OSCAR assumes the association between an item (a vector representing the item) and a control contextual element (a vector representing the successive states of the context given by the oscillators). Unlike other ordinal models, OSCAR postulates that this contextual element is always changing during the presentation of the sequence, when people perceive the sequence of items. The OSCAR is a hierarchical memory model with a three-tier structure: the item position in a subset; the subset position in a list; and the list position in a session. Thus, the oscillators of the OSCAR vibrate at different rates depending on the layer of the memory structure. Order information is retrieved by reinstating the states of the set of oscillators representing the context. Each context vector is used as a probe to recover the item vector that is the best match. Errors are the result of the quality of the contextual vector, and whether it is specific to a particular item vector or not. Similar context vectors (e.g., items presented close in time) are more susceptible to the fact that existing noise at retrieval will lead to positional uncertainty.

The models that fall under the ordinal category escape most of the existing criticisms that were put forward against the positional and chaining theories. First, ordinal models do not need to postulate the existence of feedback. Second, ordinal models can deal with the interference problem, since it is assumed that each sequence is associated to a new and specific node and, therefore, order of different sequences is stored independently, without interference.

In the almost six decades that passed since Lashley's (1951) work, there has been an impressive variability and diversity in the theoretical frameworks that were proposed to account for serial order. From classical to contemporary models, memory for serial order has been conceptualized in three distinctive ways that have contributed with major insights to the way we better understand this pervasive phenomenon of everyday life. The models differ in a variety of dimensions, from the way order information is assumed to be represented and retrieved, to its relation to item information and list positions. Each theory has its own set of strengths and weakness. Essentially, positional and chaining models differ on the retrieval cue that is used and that can either be the previous item in the sequence or an abstract positional code. The major difference between positional and ordinal models relies on whether order information is accessed independently of a contextual element or not. Positional theories assume that order can be retrieved without the context, ordinal models assume that it cannot. However, there is, still, some lack of integration and, most importantly, it is yet to be discovered an integrative theory of memory for serial order that allows the full and wide understanding of the cognitive underpinnings of serial order.

3.3.4. Long-term memory: The case of the chaining and ordinal models

The chaining and ordinal theories are the best picks for an approach to memory for order in person memory modeling. In fact, these are not the only theories that postulate the representation and retrieval of order information in a long-term memory store but, moreover, these are the models that best match the encoding, processing and retrieval assumptions of the person memory model. Even further, the chaining theory is the memory for serial order proposal that best matches the representational and retrieval assumptions of the person memory associative network model. According to the person memory model, information is represented in an associative network as discrete nodes. As such, items are nodes and nodes are associated among themselves by associative linkages in a network of interconnected nodes. Similarly, according to the chaining proposal, order information is represented in memory by means of direct associations between successive (and non-successive for compound models) inter-item (or inter-node) associations.

From the set existing models, we can isolate the TODAM chaining proposal, and the Primacy ordinal proposal, as illustrations of long-term models of memory for serial order. The TODAM is a general memory theory and, therefore, has to be able to account for the entire scope of memory, from short-term to long-term memory. The Primacy model, as other ordinal theories, deals with long-term memory representations for order information since the representational process is assumed to be independent, to a great extent, from working-memory capacity constraints.

3.3.5. Summary – *Section (3.3.)*: Theories of memory for serial order

In this section we reviewed the three theories of memory for serial order: the positional, chaining and ordinal theories. We detailed the representational and retrieval assumptions of each theory, illustrating them with some of the most important models of memory for serial order. The majority of the chaining and ordinal models are long-term memory models, a necessary feature to person memory modeling, since person memory deals with the representation of information about persons in long-term memory.

3.4. Summary – *Chapter (3)*: Memory for Serial Order in Human Memory

The third and last chapter of the introduction was dedicated to the literature of memory for serial order in human memory. This chapter was divided in three parts: the first dealing with the different types of information that are modeled by most the theoretical proposals of memory for serial order, the second describing the relation between memory for serial order and long-term memory representations, and the third detailing the three theories of memory for serial order in human memory.

Firstly, we examined the differentiation among types of information that characterizes the memory for serial order research. Item, associative and order information were disentangled, while reviewing the serial recall and serial reconstruction tasks, and the serial position function and the pattern of errors, to better understand order information representation and retrieval in memory. Secondly, long-term memory was addressed as the locus for most of the memory for serial order modeling, as well as person memory modeling. Thirdly, the three theories of memory for serial order were reviewed in detail, emphasizing the representational and retrieval assumptions of the positional, chaining and ordinal theories.

THEORETICAL PROPOSAL/CONTRIBUTION

1. The Theoretical and Empirical Proposal of the Present Project

In this chapter, entitled "Theoretical proposal/contribution", we aim to outline the ideas that will orient the experimental pursuit for a better understanding of order information in person memory that will follow in the subsequent chapter ("Experimental research"), dedicated to the experiments that have been conducted to tackle memory for serial order in person memory. The theoretical proposal(s) of the present work borrows ideas from multiple sources. Essentially, there are three literature-streams in which the current work is rooted. First, this work aims to deepen our knowledge about person memory and, consequently, derives most of its ideas and proposals from the theories and methods that have been developed in person memory literature and research for the past three decades. Second, the current work has also been influenced by the event memory literature, and its study of temporal order. Thirdly, and essentially at the theoretical level, this research work is heavily inspired by the memory for serial order literature. Indeed, we borrowed ideas from different models that have been put forward to account for the phenomena of memory for serial order, in an attempt to understand the representation of order information in person memory.

The present chapter aims to state the *theoretical location* from where we start the quest for a better understanding of order information in person memory. Our proposal(s) results from the marriage between the models of memory for serial order, event memory and the person memory model, and aims to originate an integrated theoretical possibility for the representation of order information in person memory.

1.1. Order information in person memory: A theoretical possibility

1.1.1. Three theories of memory for serial order

As we have reviewed in the introductory chapter, there are three sets of models, or theories, to account for the underlying memory processes of order information representation and retrieval in memory. This human memory literature that focus on the study of order is known as memory for serial order. Before, we described in detail the three theories of memory for serial order. Here, we will briefly review them to compare and contrast them with the person memory model.

First, the positional theory of memory for serial order posits that order is represented as an association between an item and its position in the sequence. Order is retrieved using the position as a cue to reach its associated item. The positional theory assumes, thus, item-position associations to represent and retrieve order information in memory. Second, the ordinal theory of memory for serial order postulates that order is represented by attributing to each item a value in a single ordinal dimension. Order is retrieved moving bidirectionally in the dimension, accessing the relative value of each item in the ordinal dimension. Third, the chaining theory of memory for serial order proposes that order is represented as an association between successive items, being retrieved in a chaining process, where each item cues the next item to be retrieved. The chaining theory assumes, thus, item-item, or inter-item, associations to represent and retrieve order information in memory.

1.1.2. Chaining proposal: An associative chaining person memory model for order information

The person memory model is an associative (chaining) memory model. Thus, the person memory model shares the general encoding and retrieval assumptions of the chaining theory, which is natural as both models are based on associationist principles. According to the person memory model, information is encoded and retrieved by means of a chaining mechanism, where associations between items are formed at encoding and can be used at retrieval. If such associations follow the order in which information was encoded, then the associations can be used to represent and retrieve order information in and from the person memory associative structure. However, if such associations do not follow the order in which information was encoded, as it is generally the case when people engage in impression formation (c.f., section *1.1.3. Impression formation according to the chaining proposal*), then order cannot be represented by means of associations between items in successive positions and, thus, order cannot be represented and retrieved using a chaining process.

The chaining proposal for order information representation in the memory structure describing a person postulates that order representation should follow the tenets of the chaining model of memory for serial order. Chaining models of memory for serial order assume, indeed, that information is represented in memory by the establishment of associations, or links, between items. Order information, specifically, is represented by associations between adjacent or successive items. In a similar vein, the person memory model assumes that information is represented in a network of inter-related items, with the inter-item associations playing a crucial role in person representations. Even further, the chaining model of memory for serial order and the person memory model share the same retrieval assumptions and formulate the same retrieval processes. Information is retrieved traversing the links between items in the network. The amount and type of associations differ between the chaining and the person memory models, however, the same operating processes are expected to be running to retrieve information from these associative structures. Furthermore, both the chaining theory and the person memory model have developed memory models to account for long-term memory phenomena.

The theoretical proposal for order representation in person memory within an associative chaining person memory model, heavily inspired in the chaining models of memory for serial order, asserts, quite simply, that the representation of order information in person memory would take place by the development of associations between items in temporal contiguous positions in the world. Order information would be retrieved following the direct inter-item successive associations.

In the typical person memory experimental setting this would mean that order would be represented by associating behaviors in successive positions in the stimulus list. As such, for example, the fifth item in a sequence would be associated to the fourth and to the sixth item of the list, the sixth would also be associated to the seventh, the seventh to the eight, and so forth and so on. Consequently, there would be as many inter-item successive direct associations as the amount of items in the stimulus list, minus one.

At the person memory associative network structure level, which has been reviewed extensively, this would mean that there would be inter-item associations between the items that have been presented successively. Thus, order information would be represented by means of an associative chain of items. This mechanism, a chaining process, would fit in the already known conceptualizations of the person memory model. Specifically, as far as the representation of item information goes, the model would stay as it is. However, concerning order information, the model would posit that such information would be represented by the development of associations between items in successive positions.

1.1.3. Impression formation according to the chaining proposal

However, and very importantly, the organizational processes that characterize impression formation are, generally speaking, at odds with the representation of order information *tout court*. One important aspect of the impression formation sense making processes is that they result in a hierarchically organized representation of a person in memory. This hierarchical representation has nodes at different tiers. At the top, the aggregator, the target node, below, the trait node(s), and further down, the behavioral nodes. It is the set of organizational processes triggered by impression formation that gives rise to such a hierarchical organized memory structure. In such structure, the behavioral nodes that imply the same trait are represented together in memory, all associated to the common trait node which, in turn, is associated to the aggregator person node. As such, forming an impression entails, at the most fundamental level, the (re)organization of information in memory. It is likely that such meaningful organization is rather different from the sequentiality of the stimulus in the outer world. As such, forming an impression can result in an organized and sense making representation of a person which, in turn, makes it difficult to associate the items in successive positions.

In fact, when people engage in impression formation, the associations that are built amongst the informational elements (i.e., items) tend to follow the sense making processes that characterize impression formation, resulting in a coherent gestalt that represents the target person. These associations that are built between items at encoding can be of different types. Firstly, when people form impressions based on information describing more than a single target, the organizational processes involved in impression formation tend to lead to the development of discrete cognitive representations describing the target persons. For example, if the behavior in the fifth position in the stimulus list was performed by John, and the behavior in the sixth position was performed by Peter, and if, furthermore, the item in the seventh position is another behavior performed by John and if there is a behavior in the eighth position performed by Barack, it is highly likely that there will be three distinct and independent representations being built in the perceiver's mind, each representing a specific target. In such a setting, it seems extremely unlikely that direct associative links would be established between items in successive positions that described different targets, connecting nodes in distinct person representations. As such, an item describing John and an item describing Peter, despite being perceived in successive positions in the stimulus list, have a low probability of ending up directly associated in the mental representation(s) of the two target persons, given that these two items are represented in two discrete, and independent, associative networks.

Secondly, the same overall process is expected to occur when information, even if describing a single target, refer to more than one personality trait. Assuming that information is organized and represented by trait in the person memory structure describing the target person, that is, aggregated by trait, then items describing different traits are assumed to be represented separately, in different trait clusters. For example, if the item in the fifth position of the stimulus list is an intelligent behavior, and the item in the sixth position is an altruistic behavior, and if, furthermore, the item in the seventh position is another intelligent behavior, it is highly likely that according to the organizational processes involved in impression formation, the two intelligent items will be represented together in a trait-based representation. Simultaneously, it is highly likely that the altruistic behavior will be represented together with other altruistic behaviors. Given this trait-based organization, then it is unlikely that associations between successive items (but portraying distinct traits) will still be developed. As such, the probability of an intelligent item and an altruistic item being bound in memory is low, even if these items appeared in successive positions in the stimulus list.

Thirdly, in a similar vein, when people have an *a priori* expectancy about a person, and when incongruent information is present during encoding, more associations are expected to be built between the incongruent items and the previously represented items, in an attempt to explain such intriguing information. As such, when an incongruent item is presented following any given item, besides the possible association between the incongruent item and the previous item, several other associations are expected to be built between the incongruent item and the previously encoded information. Thus, there is no single chain that can be used at retrieval that follows the order of the information in the studied material.

Fourthly, even when all information describes a single target, a single personality trait, and when no incongruent information exists, the sense making processes involved in impression formation tend to result in the formation and strengthening of the inter-item successive associations. Moreover, such sense making activity of impression formation promotes comparisons between the newly perceived item and the previously encoded ones, resulting in associations being built between the newly perceived item and (some of) the previously encoded items.

Therefore, given the impression formation sense-making processes that result in gestalt representations of the target person(s), it is not very likely that the associations built at encoding, when people form impressions, follow the order of the studied information. This is expected to be the case even in the most radical case, when information describes a single target, a single personality trait, and no incongruent information is present. Thus, the chaining proposal of order representation by means of associations between successive items should be independent of the organizational processes of impression formation, especially if successive items portray different targets and/or different traits. Even though the person memory models are chaining models, which could suggest that order would be represented and retrieved by means of inter-item successive associations, according to our hypothesis, usually the typical impression formation chaining mechanism is not informative of order. Our prediction, thus, would be that forming an impression would interfere with memory for order information. On the other hand, when people have the goal of memorizing the information, given that no gestalt is formed, and no organization by target or trait is expected to take place, memory for order information should be preserved. Thus, the first hypothesis would be that people forming impressions should not be able to extract order information.

1.1.4. Event memory proposal

According to Wyer and collaborators (1985) model of temporal order in event judgments *from the event memory literature,* people only represent and later access order of chunks, or sets of events. For these thematic units, order information is represented in positional terms, that is, the proposal postulates that temporal coding only occurs for units of temporal meaningful events, that is, groups of events with temporal relation, and no temporal coding is assumed to take place for individualized events represented in the memory structure. At the microscopical event-level, people are unable to infer order and, thus, people have to rely on external criteria to make order judgments. Such criteria must have some probabilistic validity and, therefore, tend to be based on the general knowledge people have about the world (e.g., usually at a restaurant people eat the main course before eating the dessert).

Summing up, at the microscopical event-level, within units, people are not able to directly extract order, and can only rely on external criteria to make order judgments. The proposal for the microscopical level is similar to the ordinal models of memory for serial order, where order is accessed in an indirect way. It can be said that the event memory proposal for order judgments entails a positional model for order judgments at the unit (macroscopical) level, and an ordinal model at the event (microscopical) level. Taking such notions to the person memory arena, without external cues to guide ordinal judgments between items describing a person (microscopical level), order information should not be extracted as well (e.g., there is no particular reason to think that an intelligent behavior succeeds or precedes one friendly behavior).

This event memory proposal contrasts with the chaining models, where it is postulated that order should be easier to code (when possible) between pairs of items, in comparison to chunks or groups of items, given that associations are built among the items in successive positions, not among groups of items. Given that the person memory model is an associative network model – meaning that it is a chaining model – information is represented by the association of items of information in memory, and it is retrieved using each item as a cue to retrieve the following item. This chaining mechanism, assumed to exist in the representation of information in the person memory structure, was formulated for the representation of item information. This chaining is not, in most conditions, temporal chaining (for order information), since as it was described before, the associations that are built during impression formation usually result in an organized memory structure where associations support such organization, and not the sequentiality of the perceived information.

1.1.5. Chaining proposal and event memory proposal: Two divergent models, one similar hypothesis

Despite the important and significant differences between the chaining and event memory proposals, both models are rather pessimistic in relation to the ability to represent and retrieve order information in person memory, that is, when people form impressions about individualized persons.

In the case of the chaining models, order would not be represented directly, but would be inferred by retrieving the associative connections built at encoding. Whenever such chaining that is created at encoding does not reflect the order in which information is perceived and encoded, then order cannot be retrieved by the chaining mechanism, since each item is not cueing the following item but, instead, is cueing the item to which it was associated during encoding, which can be, for example, an item illustrating the same personality trait or the same target.

In the case of the event memory model for temporal order judgments, not only order is assumed to be represented exclusively at the unit level (which is non existing in most person memory research experimental settings) but, moreover, and similarly to the chaining proposal, order would be represented indirectly. In fact, there is no representation of order at the item level, especially in settings where no external criteria can be used to reconstruct order (as it is the case when behaviors are randomly presented to participants). Hence, both models predict that forming impressions should hinder the ability to represent and retrieve order information.

Differently, the models have divergent predictions regarding the order information representation and retrieval when people memorize the information, given that the chaining models would assume that the chaining mechanism would be able to jump in to represent and retrieve order, while the event memory proposal would expect no differences between the processing goals of forming an impression and memorizing the information at the item (microscopical) level, since both processing goals should not be able to represent and retrieve order information.

If data indicates that impression formation and memorization processing goals diverge in terms of memory for order (advantage for the memorization conditions), then it suggests that the chaining models are more adequate to account for order in person memory. However, if the processing goals do not diverge in terms of memory for order, then Wyer and colleagues' (1985) model would gather support in asserting that no micro-representation of order would take place, regardless of the processing goals.

Although it was expected that the chaining promoted by the organizational processes that characterize impression formation would be at odds with the retrieval of order information, one should not assume that order information would not be retrievable whenever people form impressions. In fact, order information can be essential to understand social phenomena and even the impression formation process. Moreover, one could expect that the social knowledge, expectancies, and social norms would allow for the adequate inferential reconstruction of order in most circumstances (e.g., event memory). Still, such inferential reconstruction would not be possible in the context of the paradigms used in the current work, where items were ostensively presented in a random order and, therefore, social knowledge, or expectancies are of little use.

1.2. Summary – *Chapter (1)*: The Theoretical and Empirical Proposal of the Present Project

In this chapter we intended to lay out the theoretical ideas that guided the experimental pursuit that will follow next. The models that have been proposed are theoretical possibilities that integrate the person memory model with different representational assumptions from the event memory and memory for serial order literatures. Those are the theoretical guidelines of the present work.

2. General Hypotheses

The general hypotheses that can be drawn at this point, from the theoretical proposals that have just been described, can be divided in item memory and order memory.

Concerning item memory, both the chaining and the event memory models share the same encoding, representational and retrieval assumptions regarding item information and, as such, derive the same predictions regarding this type of information in person memory. Both proposals share the assumptions of the person memory model account for item information and, thus, the general hypothesis is that, in terms of item information, the following set of experiments will replicate the pattern of results obtained with the typical impression formation paradigm. That is, when people form impressions, compared to when they memorize the information, an organized person representation is structured in memory, leading to better performance in item information retrieval measures.

Concerning order memory, despite different representational assumptions, the chaining model and the event memory proposal have the same general prediction when people perceive information about a person with the goal of forming an impression. Both models predict, for different reasons that the organizational processes underlying impression formation interfere with the representation and retrieval of order information. That is, forming an impression will hinder people's ability to retrieve order information in order measures. According to the chaining model, forming an impression triggers a set of organizational processes that reduce the likelihood that inter-item successive associations are built, represented and accessed in the memory structure. Without these chaining associations, order memory is hindered. According to the event memory proposal, temporal coding only takes place at the macroscopical, unit level. Thus, order information should not be represented and retrieved when no such macroscopical level is present, namely when people are forming impressions based on randomly presented behaviors, which have no temporal or order relation among themselves.

However, differently, these models have distinct predictions regarding memory for order information when people perceive information with a memorization goal. When people memorize the information the sense making activity that characterizes impression formation does not take place. As such, the representation that is formed does not have the gestalt features of an impression. According to the chaining model, the absence of such organizational processes promotes the temporal or ordinal chaining, that is, the representation of inter-item successive associations is facilitated, and temporal chaining can be used at retrieval to access order information in the memory structure. Thus, according to chaining proposal, the prediction is that when people memorize the information, the chaining mechanism will facilitate the retrieval of order information. Summing up, according to the chaining model, differences are expected in terms of order memory across processing goals. According to the event memory proposal, such difference in order memory across processing goals should not be obtained, given that the temporal coding is not assumed to take place at the microscopical item-level, regardless of the processing goals. That is, the event memory proposal asserts that, irrespectively of the organizational processes that occur when people form impressions, and that are absent when people memorize the information, order should not be preserved and accessed at the item level. The temporal coding is assumed to take place exclusively at the unit level, between sets of events. Summing up, according to the event memory proposal, no differences are expected in terms of memory for order across processing goals, and performance is expected to be low on both goals.

EXPERIMENTAL RESEARCH

1. Experiment 1

The goal of the first experiment was to start the representational quest for order information in person memory. To do so we introduced a measure of order information in a classical impression formation paradigm. We designed a paradigm, adapting the original Hamilton and colleagues' (1980a) experimental setting, to allow the measurement of both memory for item information and memory for order information. The measure of order information involved presenting participants with blocks of three behaviors and asking them to order the behaviors according to their original position in the stimulus list (an order reconstruction task). The item information measure was not a true item measure to avoid a potential contamination problem that was very likely to occur if we asked participants to free recall the behaviors after having ordered blocks of behaviors (in the order measure), or vice versa. As such, item information was measured in a source memory task, which involved asking participants to identify the target that performed each of the behaviors.

Moreover, we intended to dissociate order from item information across processing goals (impression formation – IF; and memorization, both simple memorization – M, and memorization of order – MO). We decided to use two memorization processing goals to better contrast with the impression formation processing goal. In fact, the memorization of order processing goal is a further specified memorization processing goal (as opposed to the general and rather unspecific memorization processing goal) that better matches the specificity of the impression formation processing goal and the deep processing it triggers. The paradigm that was developed for experiment 1, adapting Hamilton and colleagues

(1980a) paradigm, involves multiple targets and multiple traits.

1.1. Research question

If the literature is unanimous suggesting that item information representation and retrieval profits from the processes involved in forming an impression, according to both the chaining model and the event memory proposal discussed earlier, forming impressions should interfere with order information representation and retrieval. In the first experiment we were, thus, interested in testing whether this theoretical dissociation between order and item memory was, indeed, supported by empirical data.

Still, although both the chaining and the event memory perspectives share the same overall prediction related to the order information representation and retrieval, given that these proposals postulate that order information is represented and retrieved based on distinct assumptions, they also open the field for other research questions. In fact, person memory research frequently contrasts the impression formation processing goal with a memorization goal. People are either instructed to form impressions, or to memorize the information. The chaining and event memory proposals, based on their distinct assumptions, raise different questions related to the outcomes that are likely to result from such comparison of processing goals.

According to the chaining hypothesis, when people form impressions they are not able to represent the inter-item successive associations, given that alternative associations are built to abide the sense making purposes of impression formation. Therefore, the chaining that is built during encoding when people form impressions is not, in most circumstances, ordinal or temporal chaining. But when people memorize the information no such organization takes place and the inter-item successive associations can be represented and used to retrieve order information. Thus, according to the chaining hypothesis, when people form impressions the chaining mechanism tends to be independent of order, but when people memorize information the chaining mechanism should follow the order of the information in the stimulus list, in what can be called temporal or ordinal chaining. As such, people should be able to represent and retrieve order information when instructed to memorize the information, but not when instructed to form an impression.

Differently, according to the event memory proposal – that postulates that temporal judgments are made based on real world events with inherent temporal relations, together with the general knowledge people have about the world –, the comparison between processing goals should yield no significant meaning, since both processing goals are not expected to promote the representation of order in a setting where information has no causal, or a priori temporal relation among itself, and where information is presented in random order. Thus, in such conditions, that is, in the person memory typical experimental setting, there is no macroscopical unit level where order can be represented and, furthermore, the structure of the list makes it impossible to rely on the general knowledge people have about the world to reconstruct order information at the microscopical level. As such, people should be equally bad representing and retrieving order information, irrespectively of whether they have formed an impression, or have memorized the information.

So, with this first experiment we were also interested in testing whether the contrast between impression formation and memorization processing goals result in differences (better performance for the memorization conditions), supporting the chaining proposal, or no differences, supporting the event memory proposal that order is not represented in such temporally meaningless settings.

Also, related with the chaining proposal, in a complex person memory paradigm with multiple targets and multiple traits, we were interested in knowing whether the organizational processes involved in forming an impression disrupt the representation of the inter-item successive associations. The rationale is that in multi-target, multi-trait settings, forming an impression will result in the development of discrete person representations for each target as a consequence of the sense making organizational processes involved in impression formation. At retrieval, a chaining mechanism is always employed to access information. However, such chaining follows the available associations and, if these associations have no relation whatsoever to order, then order information cannot be retrieved by the chaining mechanism.

To do so the original paradigm by Hamilton and colleagues (1980a) was modified to allow the measurement of order memory for blocks of behaviors portraying the same (and different) target(s), and blocks of successive (and non-successive) behaviors. Thus, this first study makes use of behaviors organized in successive (vs. non-successive) blocks, and intra-target (vs. inter-target) blocks and, accordingly, the experimental material describes four different targets (and also four different personality traits). This multi-target setting with organized blocks of behaviors in the stimulus material enabled us to implement the above mentioned order reconstruction task.

1.2. Hypotheses

In terms of item memory (or, more specifically, source memory), we expected that (i) memory for the item information would be better for the impression formation processing goal conditions, compared to the memorization processing goal conditions. The organizational process underlying the formation of person impressions is expected to result in a network of inter-item associations that facilitates the recall of the target node information from the person memory structure, resulting in the recall advantage for impression formation. The complexity of the stimulus material used in this first experiment (where behaviors are performed by four different targets and, at the same time, are illustrative of four personality traits), should result in the development of a more complex and organized representation of the targets, that further facilitates the recall of item information from such a memory structure. The more a memory structure is organized, the easier it is to recall information from that memory structure. Regarding the specificity of the source memory measure, it is expected that in an organized memory structure, not only there are more inter-item associative pathways to traverse the network – that result in the typical free recall advantage for item information – but more importantly, the increment in the associative pathways in the network facilitate the access to the source (target) of each item.

In terms of order memory, according to the chaining mechanism of person memory, our main prediction is that (ii) memory for the order information would be better for the memorization processing goal conditions, compared to the impression formation processing goal conditions, especially when participants had to order blocks of successive items, since the organizational processes involved in building the person memory representation – i.e., impression formation – that aggregate information by target and trait, should disrupt the original sequence of the behaviors in the stimulus sequence (especially if information describes different targets, since this information will be organized in different associative networks). As such, for the successive blocks, memorization processing conditions were expected to outperform the impression formation conditions, given that no such organizational process was triggered and, thus, the inter-item successive associations could be encoded in memory.

1.3. Method

Participants

75 undergraduate students from the School of Health Sciences of the University of

Algarve (ESSaF, Faro, Portugal) volunteered to participate in the study.

Design

Participants were randomly assigned to the cells of following factorial mixed design: 3 (processing goals: impression formation set, memorization set, and memorization of order set) X 4 (replication of the stimulus material: list 1, list 2, list 3, and list 4) X 2 (behaviors' target: intra-target vs. inter-target) X 2 (behaviors' position: successive vs. non-successive), where the last two variables were within-subjects manipulations of the stimulus list.

Material[5]

The material used in this study consisted in a subset of the behavioral descriptions pre-tested by Garrido, Garcia-Marques and Jerónimo (2004) and Jerónimo, Garcia-Marques and Garrido (2004). For this study, 16 behavioral descriptions were selected, describing four different personality traits (intelligent, friendly, artistic, and ecological) and four different targets (João, Pedro, Luís, and António). Each target performs 4 behaviors, 2 from a given personality trait, and 2 from different personality traits (e.g., a target can perform 2 ecological behaviors, 1 friendly behavior, and 1 artistic behavior). As such, although very alike, the four targets differ in the sense that each target repeats one trait and, simultaneously, lacks one of the traits. The organization of the stimulus material was counterbalanced so that each trait appears the exact same number of times over the stimulus list. Furthermore, for the present experiment, from the total of 16 behavioral descriptions, 12 were organized in four blocks of 3 behaviors each. These four blocks resulted from the combination of the variables *behaviors' target* and *behaviors' position*. Therefore, first, in one block behaviors were from successive positions and were performed by the same target. Second, there was one block with behaviors from successive positions that were performed by three different targets.

5 See *Appendix I – Experiment 1: Stimulus Material* for the entire set of stimulus material from experiment 1.

Third, one block had behaviors from non-successive positions, performed by the same target. Fourth, and finally, there was a block of behaviors from non-successive positions in the stimulus list that were performed by different targets. Four different lists were built as replication of the stimulus material. The behaviors that were in successive positions in one version were in non-successive positions in another version. Additionally, the order of the lists was also reversed, creating a total of four different versions.

Procedure

Participants were informed[6] that they would take part in a study about impression formation (or in a study about memorization or, alternatively, in a study about the memorization of order). During the study phase each one of the 16 behaviors was presented automatically during 8 seconds in a computer screen. The behaviors were presented in one of the four replications of the stimulus list. Participants performed, then, a distracter task. Lastly, they were asked, first, to order the 3 behaviors of each of the four blocks according to the original position in the stimulus list (the target of each behavior was omitted in the presentation of the behaviors). Second, participants were asked to recall the name of the target that had performed each of the 16 behaviors, in a source memory task. Behaviors were presented in a random fashion, both in the ordering and source memory tasks (as well as the blocks in the ordering task).

Dependent measures[7]

<u>Order memory</u>

The order measure consists in an index that computes, between 0 and 3, how correct each block was ordered. This measure makes use of a matrix coding system, where each one

6 For the entire set of instructions, see *Appendix I – Experiment 1: Instructions*.
7 See *Appendix I – Experiment 1: Dependent Variables* for the detailed computation of the dependent variables.

of the 6 possibilities of ordering a sequence of three elements has a value between 0 (most incorrect sequence, with the maximum possible errors) and 3 (most correct sequence, without errors), representing how close, in terms of the number of errors, the sequence is from the original sequence that was presented to participants at the study phase[8]. For these sequences of 3 items, there are 6 possible ways to sequence them: abc, acb, bac, bca, cab and cba. For example, if the correct sequence was abc, then a sequence of bca corresponds to 1 in the index of order (because b still comes before c, but the position of a is wrong relatively to both b and c) and a sequence of bac corresponds to 2 in the index of order (because both b and a come before c, but the position of b is wrong relatively to a). Participants were asked to order the four blocks of 3 behaviors.

Item memory

The measure used in this study is a proxy of item memory. Given the order measure, we chose to use a source memory measure instead of the typical item memory measure for concerns over the contamination that the use of the order memory measure employed in this study would have on a typical (free recall) item memory measure, or the other way around[9]. More specifically, such source memory measure computes, in a index, the amount of times that participants are able to correctly recall the targets that performed each behavior, in relation to the total of behaviors presented in the stimulus list. This index varies from 0 to 3, reflecting the number of critical items in which the target was correctly recalled for each one of the four blocks (note that each block has 3 behaviors).

8 See *Appendix I – Experiment 1: Dependent Variables* for a detailed description of the order memory measure, based on a matrix coding system.

9 The use of source memory tasks in the context of the impression formation paradigm was used by Garcia-Marques & Hamilton, 1996. The findings generally replicate the ones obtained by free recall/item memory measures, namely the better memory performance for the impression formation conditions compared to the memorization conditions. Furthermore, such measures circumvent the potential contamination problems that emerge from using a measure of item information before the measure of order information, or vice-versa.

1.4. Results[10]

Item Memory

The source memory index was entered in a 3 (processing goals: impression formation set, memorization set, and memorization of order set) X 4 (replication of the stimulus material: list 1, list 2, list 3, and list 4) X 2 (behaviors' target: intra-target vs. inter-target) X 2 (behaviors' position: successive vs. non-successive) factorial ANOVA, with the last two factors being within-subjects.

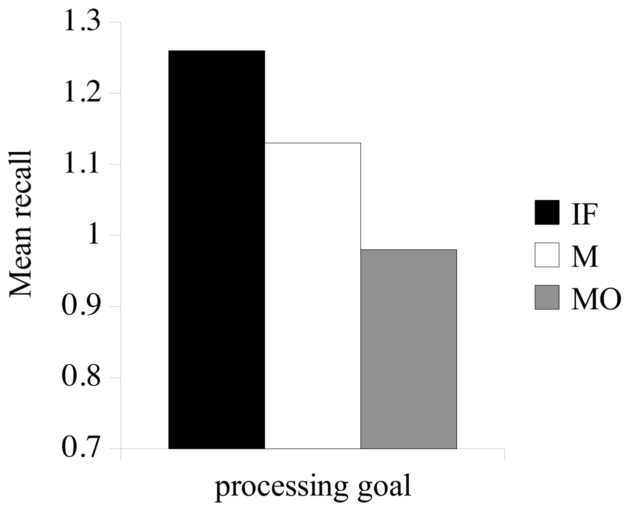


Figure 6: Mean recall of targets as a function of the processing goal (IF: impression formation; M: memorization; MO: memorization of order).

Data seem to suggest, as predicted, a marginally significant main effect (Figure 6, above) of the processing goals, F (2,63) = 1.89, $p < 0.16$, with impression formation participants recalling better the source of the behaviors (M = 1.26), compared to the memorization participants (M = 1.13), or the memorization of order participants (M = 0.98). Moreover, the planned comparison between impression formation and the other two conditions is marginally significant, t (63) = 1.59, $p < 0.06$ (one-tailed) (planned comparison:

10 See *Appendix I – Experiment 1: Test of Normality and Homogeneity of Variances* for the tests of normality and homogeneity of variances.

M vs. MO: t (63) = 1.03, p = 0.31). This effect is not moderated by any of the remaining variables.

Order Memory

The memory for order index was also submitted to a 3 (processing goals: impression formation set, memorization set, and memorization of order set) X 4 (replication of the stimulus material: list 1, list 2, list 3, and list 4) X 2 (behaviors' target: intra-target vs. inter-target) X 2 (behaviors' position: successive vs. non-successive) factorial ANOVA, with the last two factors being within-subjects.

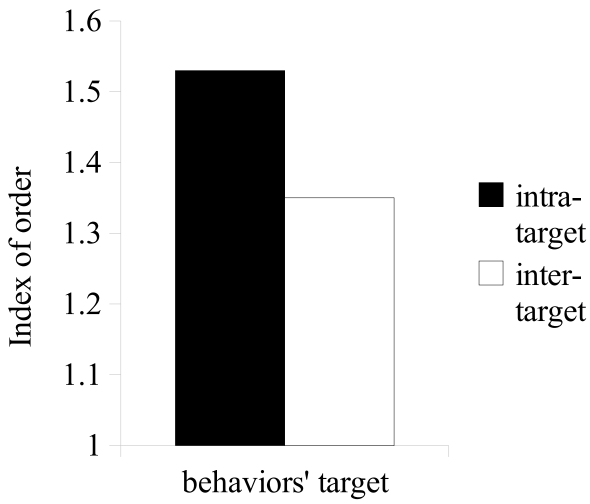


Figure 7: Index of order (0-3) as a function of the behavior's target.

This analysis reveals a marginally significant main effect (Figure 7, above) of the behaviors' target, F (1,63) = 3.06, $p < 0.085$, suggesting that participants did a better job ordering the behaviors when they belonged to intra-target blocks (behaviors performed by the same target) (M = 1.53), compared to the inter-target (behaviors performed by different targets) (M = 1.35) blocks.

However, of further importance is the fact that such effect was qualified (Figure 8, bellow) by the processing goals, F (2,63) = 4.60, $p < 0.01$, suggesting that impression formation conditions (M = 1.79) are better at retrieving order information from same target behaviors, compared to the memorization conditions (M = 1.25) and memorization of order conditions (M = 1.55) (planned comparison, for intra-target, IF vs. M and MO: t (63) = 5.94, $p < 0.02$, one-tailed). Regarding inter-target behaviors, data suggests that there are no differences between the impression formation conditions (M = *1.18*) and the memorization (M = 1.44), and memorization of order (M = 1.42) conditions together (planned comparison, for inter-target, IF vs. M and MO: t (63) = 1.40, p = 0.09, one-tailed). Additionally, impression formation conditions (M = 1.79) were better at retrieving order information from the same target, compared to different targets (M = *1.18*) (planned comparison, for IF, intra vs. inter: t (63) = 3.24, $p < 0.00$, one-tailed).

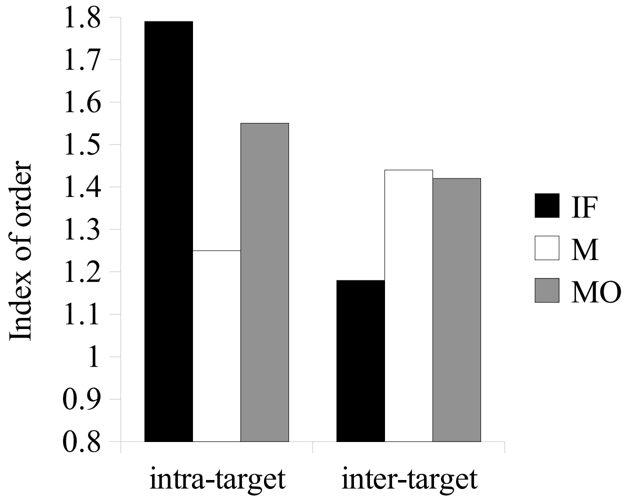


Figure 8: Index of order (0-3) as a function of the processing goal and behavior's target.

Furthermore, there is an interaction (Figure 9, bellow) between behaviors' target and behaviors' position, F (1,63) = 8.85, $p < 0.01$, suggesting that successive behaviors are better ordered when they are from the same target (M = 1.72), than when they are from different targets (M = 1.22) (planned comparison, for successive behaviors, intra vs. inter: t (63) =

3.18, $p < 0.01$, one-tailed), with the differences disappearing for the non-successive behaviors (intra-target: $M = 1.33$; inter-target: $M = 1.47$) (planned comparison, for non-successive behaviors, intra vs. inter: t (63) < 1, $p = 0.17$, one-tailed). Also, intra-target behaviors are better ordered when they are in successive positions ($M = 1.72$), compared to non-successive positions ($M = 1.33$) (planned comparison, for intra-target behaviors, S vs. NS: t (63) = 2.20, p < 0,02, one-tailed).

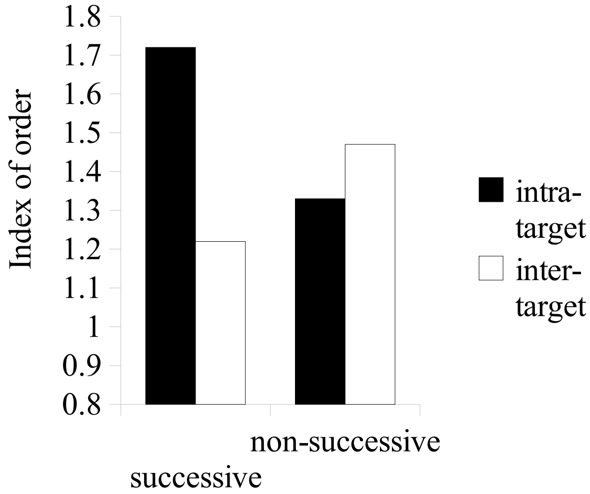


Figure 9: Index of order (0-3) as a function of the behavior's target and behavior's position.

1.5. Discussion

Results of experiment 1 demonstrate, in a multi-target paradigm, that item information (via a source memory task) was better retrieved under impression formation goal conditions, replicating Garcia-Marques and colleagues (2002) results, where a measure of source information was used. Order information was not different among processing goals. However, participants more easily ordered blocks of behaviors from the same target, compared to behaviors from different targets. Furthermore, and of more interest, it was possible to verify that this effect was moderated by the processing goals, where forming impressions, compared to memorizing the list, constituted an advantage to the retrieval of order information for blocks of behaviors from the same target, whereas there was no difference across processing goals for the blocks of behaviors performed by different targets. Additionally, for the blocks of successive behaviors, order information was better retrieved when behaviors were performed by the same target, compared to when behaviors were performed by different targets. However, there was no interaction with the processing goals.

We expected that given the organizational processes involved in forming impressions, impression formation would facilitate the access to the person node (source memory). Results support this hypothesis. Participants instructed to form impressions performed better in identifying the target of the behaviors than participants instructed to memorize the information. This data replicates the finding that forming impressions also conducts to better source memory (Garcia-Marques, et al., 2002), which constitutes further evidence to the theoretical conceptualization of person impressions as networks of items associated in memory, connected to a central person node.

In terms of order memory, since the behaviors portray different targets, the organizational processes that characterize impression formation should result in target based impressions that represent all information about the target together in an associative person network. Given Wyer and colleagues model (1985), no differences should be obtained between processing goals, since behaviors have no temporal relation (i.e., behaviors were presented in a random order), and no general knowledge about the world can be recruited to reconstruct order. Alternatively, the person memory associative structure proposal predicted that forming impressions would hinder the representation and retrieval of order information, especially for blocks of successive items, given the alternative organization that was built at encoding (by target). The alternative organization was expected to disrupt the representation of the successive relations between items in the stimulus list, making it difficult to keep track of order in the discrete person representations. The person memory associative structures (i.e., impression formation conditions) would represent all the information from a given target together (in a single network), not keeping track of order of successive associations between items from different targets (in different networks). Results of the order measure do not support this hypothesis, since the interaction between processing goals and behaviors position did not reach statistical significance. For blocks of successive behaviors, participants that formed impressions did not differ from participants that memorized the information in the order measure.

In fact, surprisingly, forming impressions resulted in better memory for order when ordering behaviors from the same target, compared to ordering behaviors from different targets. Thus, in such multiple target experimental setting, forming impressions seemed to have resulted in the development of as many impressions as the amount of targets portrayed in the stimulus material. Consequently, when participants that formed impressions had to order behaviors from the same target, they were better retrieving order information than when ordering behaviors from different targets.

This data seems to be at odds with the chaining proposal, where the sense making activities involved in impression formation, that would follow an encoding chaining mechanism independent of order, would hinder the ability to represent and retrieve order information. Differently, forming impressions resulted in better performance in ordering behaviors from the same target. But, an interaction between behaviors' position and target reached significance, suggesting that people more easily retrieve order from successive items when information described the same target, which seems to be in line with the chaining ideas.

However, an important caveat must be addressed. Given that cognitive resources are limited, it is likely that the complexity of the task (with multiple targets) lead the impression formation sense-making activity to prioritize the organization of information in memory.

Thus, if items describe multiple targets, the priority organizational process involves associating items by target. Therefore, few resources are then available to the remaining elaboration work, that promotes other associations, namely associations between items. This means that the fact that the stimulus material portrayed multiple targets may have lead, the sense making processes involved in impression formation to promote temporal chaining within target categories, or target representations, even in the impression formation conditions. If that is the case, then forming impressions in this paradigm would mean that an ordinal or temporal chaining would be artificially promoted by the impression formation processing goal. In the context of target-based associative network representations, items describing the same target are clustered together and, thus, inter-item ordinal associations within target can be indirectly promoted. In these multiple target scenarios, forming impressions can result in the development of inter-item intra-target successive associations, without further associations being built, that is, other inter-item associations are not expected to occur. Thus, in the following research we will attempt to find the double dissociation in a single person paradigm.

Summing up, in the first study we were able to introduce a measure of order information which allowed us to access order by the match between the order in which participants ordered the behaviors and the actual order in which the stimuli were presented. This measure accesses the degree in which the retrieved order matches the actual order, in a way that takes into account not just the absolute position of the item in the sequence, but also the relative position of the item regarding the remaining items in the sequence. The consequence of using such a measure, based on a block system, is that instead of item we had to rely on the use of source information, a proxy of item information. Still, we were able to dissociate item information across processing goals. Order information followed the exact same pattern, being dissociated across processing goals for behaviors performed by the same target. In this case, forming impressions outperforms memorizing the information in ordering behaviors. The double dissociation was not obtained since in the successive behaviors, where memorization was expected to result in better ability to retrieve order information, nothing happened. However, the order reconstruction task employed in this study is not especially adequate to measure chaining. In fact, it taps into order information but it is not sensitive to the chaining associations that can be used at retrieval.

In addition, the global performance in the order measure was low, suggesting that our experimental setting, together with the order reconstruction task, made it very difficult to retrieve order information.

Finally, with this first experiment we are able to assert that the memorization of order processing goal seems to be a fair processing goal condition to contrast with impressions formation, both from the theoretical and methodological point of view. Data seems to indicate that, if something, the memorization of order is a better contrasting point to impression formation, as demonstrated by the source memory results.

2. Experiment 2

Experiment 2 still constitutes an attempt to start pursuing the systematic study of memory for serial order in person memory. The goal of the second experiment was to introduce new measures of item and order information in a simplified paradigm, with a single target, in an attempt to circumvent the caveat addressed in the discussion of the previous experiment. Again, in an adaptation of Hamilton and collaborators' original paradigm (1980a), at the dependent measure phase we had a measure of order information and a measure of item information. Item information was measured in a free recall task, taking into account the amount of items participants recalled. Regarding order information, actually we had two measures to access order memory. In addition, order information was measured in a simplified ordering task (or order reconstruction task), where participants were asked to report whether each item belonged to the first, second, or third part of the stimulus list. On the other hand, order information was measured with a direct chaining measure that accessed the degree in which participants retrieved new information using the previously retrieved item as a cue to retrieve the following item. Moreover, the goal of this second experiment was to extend the dissociation of order (and item information) across processing goals, from the experimental setting of the first study (multiple targets and multiple traits) to a single target and single trait paradigm. Here, in this experimental setting with a single target, contrarily to the previous experiment, information cannot be organized by target, and thus no indirect promotion of temporal chaining should take place.

2.1. Research question

From the results obtained in the first study, the research question in this second study is concerned with whether the dissociation of order from item memory across processing goals, that was not obtained in the previous study, can be obtained in a paradigm with a single target. If such dissociation (better item memory for impression formation, but better order memory for memorization and memorization of order) is found, then, according to the chaining models of memory for serial order, order would be represented by means of a chain of associations between successive nodes, that is, by means of inter-item associations between successive items in the stimulus list. The processing goal that best promotes the development of such successive associations should be expected to result in better memory for the order information. Again, as described in the previous experiment, the organizational processes involved in forming an impression should disrupt this temporal chaining, that is, the inter-item successive order associations that represent order information.

In the context of the paradigm of this second experiment, all behavioral descriptions refer to the same single target. It can be expected that impression formation organizational activity will result in the development of associations between the newly perceived item and some of the previously encoded items, already represented in the memory structure describing the target. This organizational activity should hinder the development of the inter-item successive associations between the items in the contiguous positions in the stimulus list.

The question is, thus, do persons representations – impressions – interfere with the representation of order information, especially in settings where order information has no informational value? According to the predictions that were laid out in the previous experiment, the memorization processing goal should promote, to a higher degree, the development of associations between items in successive positions, resulting in better memory for order, compared to the impression formation processing goal conditions. Therefore, a dissociation of order information should be expected, with memorization outperforming the impression formation conditions, in retrieving order information.

2.2. Hypotheses

In this second study we expected that (i) memory for item information would be better under impression formation goal conditions than under memorization goal conditions. The impression formation advantage in item information would be a consequence of the organizational process triggered by the processes involved in forming a person impression, where a network of inter-item associations is created during encoding, facilitating the retrieval of item information.

Given the experimental setting with a single target, and the results from experiment 1 that indicated the insufficiency of Wyer and colleagues' proposal (1985), that postulated that temporal judgments were based on temporal coding only for the unit level and based on the general knowledge people have about the world, we expected, in line with the chaining proposal, that for (ii) memory for order information (both for the measure of order, as well as for the measure of chaining), people that memorized the information should be better at retrieving order information than people that have formed impressions. In such a setting (single target/trait) the extra-processing that characterizes the organizational process underlying impression formation would result in the development of associations to the already encoded information, interfering with the development of associations between items in successive positions. Therefore, we expected that the memorization conditions would surpass the impression formation conditions in the attribution of each behavior to its correspondent third of the stimulus list, and also in the likelihood of following a chaining process when retrieving information from memory in the free recall measure.

2.3. Method

Participants

56 first year undergraduate psychology students from the Lisbon University Institute (ISCTE, Lisbon, Portugal) participated in the study in exchange for course credit.

Design

Participants were randomly assigned to the 3 levels (processing goals: impression formation set, memorization set, and memorization of order set) of a single factor.

Material[11]

The material used in this study consisted in a subset of the behavioral descriptions pre-tested by Garrido, Garcia-Marques and Jerónimo (2004) and Jerónimo, Garcia-Marques and Garrido (2004). A single target performed 18 behavioral descriptions. 12 behaviors were illustrative of the personality trait friendly and 6 were neutral.

Procedure

Participants were informed[12] that they would take part in a study about impression formation (or in a study about memorization or, alternatively, in a study about the memorization of order). During the study phase each one of the 18 behaviors was presented automatically during 8 seconds in a computer screen. The behaviors were presented in a random order. Then participants performed a distracter task. Lastly, they were asked to free recall the behaviors saying at that moment, for each of the behaviors recalled, if it belonged to the 1st, 2nd or 3rd part of the stimulus list.

11 See *Appendix II – Experiment 2: Stimulus Material* for the entire set of stimulus material from experiment 2.
12 For the entire set of instructions, see *Appendix II – Experiment 2: Instructions*.

Dependent measures[13]

Item memory

Proportion of free recalled behaviors in relation to the total of behaviors presented in the stimulus list.

Order memory

Proportion of correctly ordered behaviors (i.e., attributed to the correct third of the list) according to the total of recalled behaviors.

Chaining

Proportion of times that after recalling a behavior, participants will recall its subsequent or antecedent behavior. This measure is independent from the item measure, since the difference in the amount of items recalled only affects the discriminability of the chaining measure, which varies always between 0 (no chaining) and 1 (perfect chaining). This measure is an indirect way to measure order information that, nevertheless, is adequate from the theoretical chaining perspective.

2.4. Results[14]

Item Memory

The item memory proportions were entered in a 3 levels' (processing goals: impression formation set, memorization set, memorization of order set) one-way ANOVA.

Data shows, as predicted, a main effect (Figure 10, bellow) of the processing goals, $F(2,53) = 14.30$, $p < 0.00$, replicating the previous experiment with a measure of item

13 See *Appendix II – Experiment 2: Dependent Variables* for the detailed computation of the dependent variables.

14 See *Appendix II – Experiment 2: Test of Normality and Homogeneity of Variances* for the tests of normality and homogeneity of variances.

information (free recall), with impression formation participants recalling a higher proportion of behaviors (M = 0.51), compared to the memorization participants (M = 0.35), or the memorization of order participants (M = 0.29) (planned comparison IF vs. M and MO: t (53) = 5.05, $p < 0.00$, one-tailed; planned comparison: M vs. MO: t (53) = 1.55, $p < 0.07$, one-tailed).

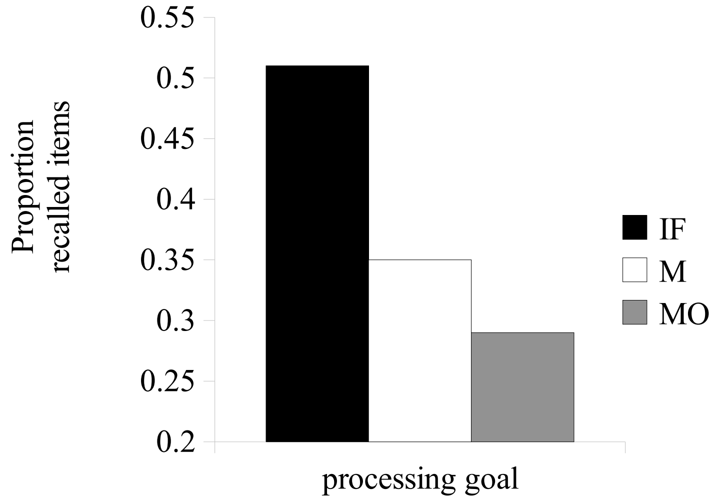


Figure 10: Proportion of recalled items as a function of the processing goal.

<u>Order Memory</u>

The memory for order proportions were submitted to a 3 level's (processing goals: impression formation set, memorization set, memorization for order set) one-way ANOVA. This analysis reveals that the processing goals had no impact in the correct attribution of the behaviors to the three thirds of the stimulus list, F (2,53) < 1 (IF: M = 0.61; M: M = 0.61; MO: M = 0.63).

<u>Chaining</u>

The chaining proportions were introduced in a 3 level's (processing goals: impression formation set, memorization set, memorization for order set) one-way ANOVA.

Data seem to suggest a main effect (Figure 11, bellow) of the processing goals, $F(2,53) = 2.40$, $p < 0.10$, illustrating that participants that formed impressions used more the sequence of the behaviors in the stimulus list as a cue to recall behaviors ($M = 0.33$), compared to participants who simply memorized ($M = 0.19$), or memorized the order of the behaviors ($M = 0.24$), although it fails to reach statistical significance. However, more importantly, the planned contrast between impression formation and the two memorization conditions, together, shows that impression formation used more chaining, than the memorization conditions, $t(53) = 2.09$, $p < 0.02$. (planned contrast M vs. MO: $t(53) < 1$).

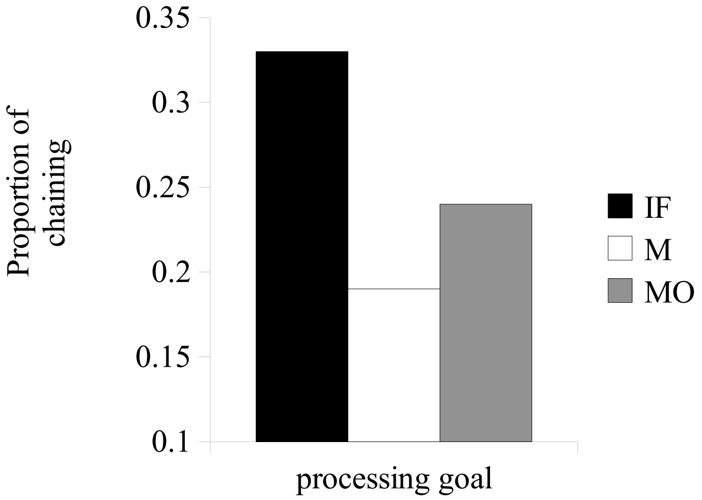


Figure 11: Proportion of chaining as a function of the processing goal.

2.5. Discussion

Results of experiment 2 indicate that item information was better retrieved under impression formation goal conditions, replicating the findings obtained by Hamilton and colleagues (1980) and Garcia-Marques and colleagues (1996; 2002), as well as experiment 1, but with a different measure. Order information was not different among processing goals, with all three conditions ranking high (around 0,6) in the proportion of behaviors correctly attributed to the respective third of the list. However, of more interest, the data from the chaining measure, a measure that can be considered a proxy of memory for order information, contradicts our prediction, indicating that impression formation outperforms memorization of order in terms of memory for order information. Surprisingly, not only impression formation keeps track of order information, but also it seems to do so in a chaining mechanism. That is, when participants formed impressions, after recalling a behavior there is a higher probability of recalling the subsequent (or antecedent) behavior in the stimulus list, compared to the memorization conditions. So, people are equally good in the order judgments, but it seems that impression formation participants make more use of a chaining mechanism to retrieve information, than memorization participants. However, before we abandon the impression formation chaining hindering hypothesis, a new caveat can be stressed. It should be noted that this experiment used a single target and single trait paradigm. Therefore, the elaboration triggered by impression formation is relatively low because all behaviors illustrate the same personality trait. Elaboration tends to increase with the presence of multi-trait, or incongruent, information. It is, thus, understandable that participants did not go beyond the simple associations between items in the successive positions, with impression formation instructions promoting the representation of information using temporal chaining.

We expected that impression formation would facilitate the recall of item information given the organizational processes involved in forming impressions. Results support this hypothesis. Participants instructed to form impressions recalled more behaviors than participants instructed to memorize the information. These data replicates the finding that forming impressions conducts to better access to the encoded information, with the most typical measure in the literature – free recall. This effect has been obtained with free recall tasks (Garcia-Marques & Hamilton, 1996; Hamilton, et al., 1980), but also with source memory tasks (Garcia-Marques, et al., 2002). This data constitutes further evidence to the theoretical conceptualizations of person impressions as networks of items associated in memory.

We expected that impression formation would interfere with the retrieval of order information given the elaboration and the organizational processes triggered by such processing goal. Forming impressions should promote the development of multiple inter-item associations. Results of the chaining measure do not support this hypothesis. Participants that formed impressions, after recalling a behavior, were more likely to recall the behavior that was in an adjacent position in the stimulus list (either the subsequent or the antecedent). Thus, the option for a single trait paradigm may have been the wrong way to try to find the dissociation.

Experiment 2 also brings additional evidence to the notion that order information representation in the domain of person memory does not seem to follow the tenets of the model advance by Wyer and colleagues (1985) to account for temporal order judgments in event memory. In fact, experiment 1, together with experiment 2 both suggest that order information is represented at the item level, which is at odds with the proposal that temporal coding would only take place at the unit level, and not at the lower (item) level.

A note to the use of the two memorization processing goals should also be made. The reason that lead us to introduce the memorization of order processing goal, and not simply the traditional memory processing goal, was a theoretical one. It is possible to argue that the (general) memorization processing goal is an unbalanced term of comparison for the impression formation processing goal, since it is broader in its scope and, thus, differences between impression formation and memorization processing goal conditions can be due to other reasons, and not necessarily the consequence of the organizational component of impression formation. Data from this experiment indicates that both memorization processing goals originated similar results and, if something, in item memory the memorization of order processing goal seemed to be a better contrasting processing goal than (general) memorization.

3. Experiment 3

With the third experiment we intended to develop a paradigm where chaining is not correlated with the ability to retrieve order information, as it was the case of the previous experiments, where the material describing a single target and a single personality trait (or in experiment 1, describing multiple targets and traits) may have promoted that the temporal chaining process that occurs in impression formation was temporal chaining, which resulted in the facilitation of order information representation. Thus, we developed a multi-trait (single target) paradigm for experiment 3, where the natural chaining involved in impression formation (trait clustering) should clearly interfere with order information representation and retrieval. For this third experiment we adapted the measure of order memory used in experiment 1 (based on a matrix coding system), into a setting that would allow us the temporal simultaneity of item and order information measurement, as it was the case in experiment 2. Item information was measured, like in the second experiment, in a free recall task, counting the amount items participants were able to retrieve from memory. Order information, differently, was measured in a new way, combining the matrix coding system from the first experiment (that computed how alike a sequence of items resembled the original sequence of items presented at the study phase), with the sequences of behaviors recalled by participants. Specifically, when participants recall behaviors they produce a string of items, that is, a sequence. The matrix coding system is, then, used to determine how closely the recalled sequence resembles the original stimulus sequence. Consequently, it is possible to know how order information was preserved in memory. The more the recalled sequence resembles the original sequence, the better the memory for the order information.

Furthermore, in this third experiment our goal is still to understand the reasons why the double dissociation that was expected for experiment 1 should (or should not) be obtained. This dissociation of order and item information across processing goals is based on the assumption that the chaining mechanism that characterizes impression formation should be independent of order, and consequently independent from the successive associations. As such, if forming an impression disrupts, at least in a certain level, the successive associations in the stimulus list to built a meaningful person impression, then impression formation should hinder the ability to retrieve order information. Given that the experimental setting used in this study is of a single target that performs behaviors implying different personality traits, the double dissociation is expected since the organizational processes triggered by impression formation (organization by trait, that is, behaviors aggregated by trait in the person memory structure) should disrupt the sequence of behaviors in the stimulus list.

The results obtained in the two initial experiments in terms of the two memorization processing goals lead us to adopt, from this experiment onwards, the memorization of order processing goal as the sole term of comparison with the impression formation processing goal. Furthermore, we kept the experimental setting in a multi-trait, single target, paradigm.

3.1. Research question

With the third experiment we intended to better understand the dissociation of order information across processing goals. Findings from the previous two experiments were not thorough in providing a picture of how order and item information are dissociated across processing goals. The research question of this third experiment is related to the nature of such order and item information dissociation. To do so we introduced a second retrieval strategy to contrast with the free recall instructions used before. As such, at the recall stage, participants were either asked to free recall the information, exactly like experiment 2, or to recall the information following the order of the stimulus list sequence. This retrieval goal manipulation intends to contrast situations where people may retrieve information freely, with situations where people are led to recall the studied information using a specific strategy.

On the one hand, results obtained in the previous experiments suggest that when information describes a single target and a single personality trait, forming impressions results in better memory for order than memorizing the order of the information. This is, by itself, a novel and counter-intuitive effect. On the other hand, results from the first experiment show that in a multi-target and multi-trait paradigm, order information was preserved when people formed impressions, but only when ordering behaviors performed by the same target. In fact, the finding that participants that formed impressions were better at retrieving order for behaviors from the same target, compared to behaviors from different targets, illustrates that forming impressions results in a person-trait based organized person memory structure. However, both these findings have alternative explanations. In fact, both in experiment 1 (multiple target and trait) and experiment 2 (single target and trait), instead of impression formation being promoting an alternative organization of the information, independent from the temporal order or the successive associations and, thus, resulting in a representation with a pattern of inter-item associations that did not reflect inter-item successive associations, the characteristics of the stimulus material may have promoted that the spontaneous chaining that occurs in impression formation followed temporal order, that is, the impression formation chaining that in other circumstances would not be linking items in successive positions, in the present context is temporal chaining, associating items in contiguous positions. That is, in experiment 1, given the multiple target stimulus material, impression formation may have lead to several target clusters. Here, information is aggregated together in the clusters and, within the clusters, temporal associations may have been developed given that no other competitive associations disputed the elaboration that characterizes impression formation, and thus order information may have been preserved. In experiment 2, no other associations, apart from the successive associations, were necessary to extract meaning about the target, given that all information was equal (i.e., described the same target and trait), and thus, such setting may have also promoted temporal chaining, instead of an alternative organization with a chaining independent from order.

Furthermore, there was evidence suggesting that the impression formation organizational processes did not disrupt, as expected, order information representation for conditions where the organizational processes would be at odds with the representation of order, as it was the case of the successive (and inter-target) blocks in the previous experiment. Impression formation conditions did not seem to hinder participants' ability to retrieve order from successive behaviors, where impression formation performance in retrieving order was not different from the memorization of order conditions. It is, thus, necessary to develop a paradigm where the natural chaining involved in impression formation (trait clustering) should hinder the representation and retrieval of order information.

According to the previous experiments, despite the above-mentioned caveats, it seems that order was represented when people formed impressions about other persons. By manipulating the recall strategies used by participants to access the memory structure we expect to have a better insight into the representation of order in the person memory structures. Namely, whether the dissociation of order information is dependent on the retrieval strategy being used.

3.2. Hypotheses

In the third study we expected that (i) memory for item information would follow the pattern obtained in the last two studies, that is, that item memory would be better under impression formation goal conditions than under memorization of order goal conditions. The reasons for the impression formation advantage are exactly the same as stated before, that is, a consequence of the network of inter-associations between the items in the memory structure.

In terms of (ii) memory for order information, and given the multi-trait experimental setting, according to the chaining hypothesis we expected the general opposite effect, since the organizational processes involved in impression formation would arrange the information by trait, disrupting the sequence of items in the stimulus list. That is, since information describes a single target (circumventing the caveat of study 1, where information described different targets) and multiple traits (circumventing the caveat of study 2, where although information described a single target, all information was illustrative of a single trait), we expected that impression formation sense making activity would be at odds with temporal chaining and thus order information would not be preserved.

Regarding the recall mode, contrasting free recall and ordered recall implies to contrast a recall strategy that occurs naturally when people have to remember information they have previously encountered, with a recall strategy that forces participants to report information in a specific order. When people free recall the information, it is expected that information is retrieved making use of a chaining mechanism, based on the associations formed at encoding. When people recall the information following the studied order, then if the associations formed at encoding are based on temporal chaining, people should be able to recall information by order, but if the chaining formed at encoding is independent of order, the ability to retrieve information, on the one hand, and the ability to do so following the order of presentation of the information, on the other hand, should be both diminished.

3.3. Method

Participants

103 undergraduate students from the University of California, Davis (UC, Davis, USA), participated in the experiment in exchange for course credit.

Design

Participants were randomly assigned to the cells of a 2 (processing goals: impression formation set vs. memorization of order set) X 2 (recall mode: free recall vs. ordered recall) factorial design.

Material[15]

The material used in this study consisted in a subset of the behavioral descriptions pre-tested by Fuhrman, Bodenhausen, & Lichtenstein (1989). For this study, 20 behavioral descriptions were selected, describing four different personality traits (intelligent, friendly, adventurous, and extraverted) and one single target. As such, the target performs 5 behaviors from each of the four personality traits, in a total of 20 behaviors.

Procedure

Participants were informed[16] that they would take part in a study about impression formation (or in a study about the memorization of order). During the study phase each one of the 20 behaviors was presented automatically during 6 seconds in a computer screen. The behaviors were presented in a random order. Then participants performed a distracter task. Lastly, they were either asked to free recall the behaviors that were presented at the study phase, or, alternatively, to recall the behaviors in the order they were presented in the stimulus list.

15 See *Appendix III – Experiment 3: Stimulus Material* for the entire set of stimulus material from experiment 3.

16 For the entire set of instructions, see *Appendix III – Experiment 3: Instructions*.

Dependent measures[17]

Item memory

Proportion of free recalled behaviors in relation to the total of behaviors presented in the stimulus list.

Order memory

Index that computes, between 0 and 1, how correct the recalled sequence resembled the original stimulus sequence. This measure is an adaptation of the measure used in experiment 1. However, if in the first experiment the sequences were constant, always with three elements, in the present experiment, the sequences vary according to the quantity of items recalled[18]. Therefore, there is a matrix by participant, with N X N cells (where N corresponds to the number of items recalled). Still, as with the chaining measure from the previous experiment, this order measure always varies between 0 and 1, granting the independence of memory for order and memory for item. It only involves a more complicated computation of the index.

3.4. Results[19]

Item Memory

The item memory proportions were entered in a 2 (processing goals: impression formation set vs. memorization of order set) X 2 (recall mode: free recall vs. ordered recall) factorial ANOVA.

Data shows, as predicted, and replicating the previous experiments, a main effect (Figure 12, bellow) of the processing goals, F (1,99) = 16.35, p < 0.00, with impression

17 See *Appendix III – Experiment 3: Dependent Variables* for the detailed computation of the dependent variables.

18 See *Appendix III – Experiment 3: Dependent Variables* for a detailed description of the order memory measure, based on a matrix coding system.

19 See *Appendix III – Experiment 3: Test of Normality and Homogeneity of Variances* for the tests of normality and homogeneity of variances.

formation participants recalling more behaviors ($M = 0.43$), compared to the memorization of order participants ($M = 0.32$).

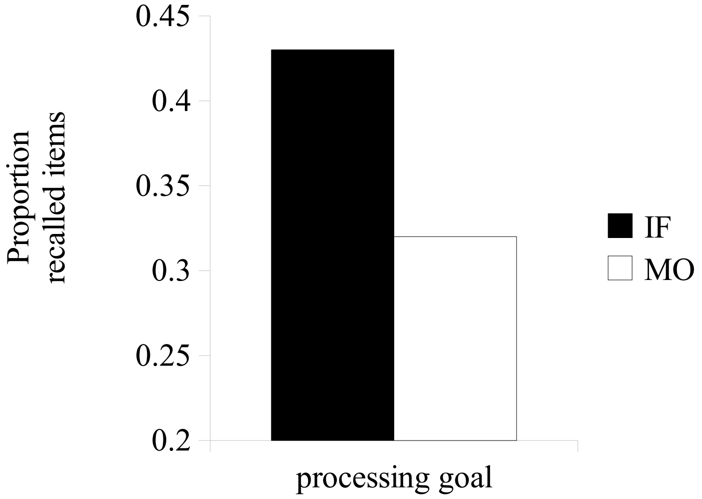


Figure 12: Proportion of recalled items as a function of the processing goal.

Order Memory

The memory for order index was submitted to a 2 (processing goals: impression formation set vs. memorization of order set) X 2 (recall mode: free recall vs. ordered recall) factorial ANOVA.

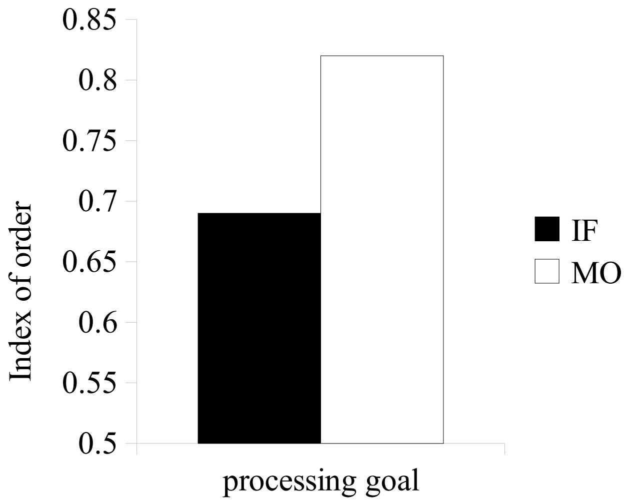


Figure 13: Index of order (0-1) as a function of the processing goal.

This analysis reveals a main effect (Figure 13, above) of the processing goals, F $(1,99) = 9.49$, $p < 0.00$, illustrating that participants that memorized the order were able to better retrieve the behaviors from the stimulus sequence in the correct order (M = 0.82), compared to the impression formation conditions (M = 0.69).

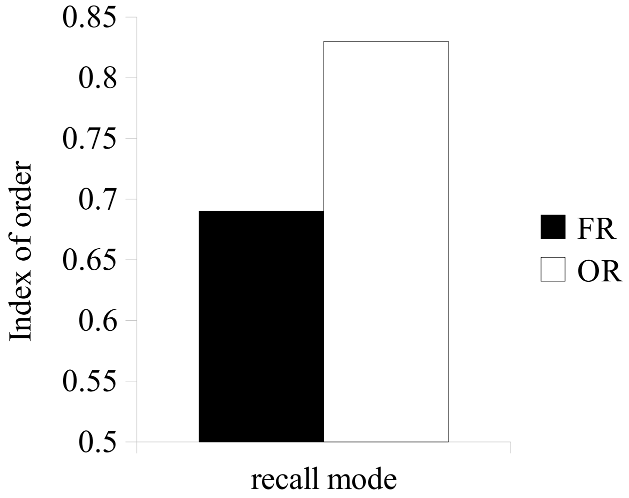


Figure 14: Index of order (0-1) as a function of the recall mode.

Additionally, the results show a main effect (Figure 14, above) of the recall mode, F $(1,99) = 11.76$, $p < 0.00$, indicating that retrieval was based on order information (i.e., the sequence more closely resembles the original stimulus list) when participants attempted to recall the information following the original sequential order (M = 0.83), compared to when participants freely recall the behaviors (M = 0.69).

However, there was an interaction (Figure 15, bellow) between the processing goals and the recall mode, F $(1,99) = 2.62$, $p < 0.11$. In free recall, impression formation participants (M = 0.59) rely less (planned comparison: t $(99) = 10.73$, $p < 0.00$, one-tailed) on order information to retrieve items from memory, compared to the memorization of order participants (M = 0.78), whereas in ordered recall, that is when specifically instructed to recall the information keeping track of order, impression formation participants (*M* = 0.80) were as good (planned comparison: t (99) = 1.09, p = 0.30) following the order in which the information was presented at the study phase, as the memorization of order participants (*M* = 0.85). The planed contrast between the impression formation conditions in free recall and ordered recall, t (99) = 12.38, p < 0.00, one-tailed, also indicates that impression formation participants retrieved items based on order information more in the ordered recall (*M* = 0.80) conditions, compared to the free recall (*M* = 0.59) conditions.

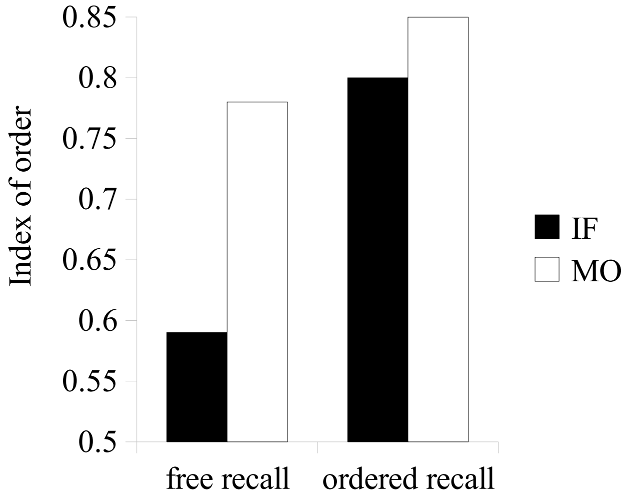


Figure 15: Index of order (0-1) as a function of the processing goal and recall mode.

3.5. Discussion

The results from the third experiment demonstrated a (n apparent) double dissociation of item and order memory, across processing goals. Item information was better retrieved when participants formed impressions, replicating experiment 1 and 2 with the same measure used in experiment 2, but in a multi-trait paradigm. Order information, on the other hand, was better retrieved (or more used) when participants memorized the order of the information presented at the study phase. However, this finding was qualified by the recall mode (i.e., by the way participants reported the content of what they had in memory), with this pattern being found only when participants free recalled the information, and not when they recalled the information attempting to keep track of order.

In this third study we expected that impression formation would facilitate the retrieval of item information as a consequence of the associative links between items in the memory representation. Results support this hypothesis. Indeed, participants that formed impressions recalled more behaviors than the participants that had memorized the order of the items. The data replicates previous findings, bearing further evidence to the conceptualization of impressions as coherent and organized memory structures. Of further interest is the fact that the manipulation of the recall strategy people used to retrieve information did not affect the ability to recall item information. Thus, when participants were instructed to recall the information in the order the information was perceived, their ability to retrieve items was not affected by such recall instructions.

Additionally, we expected that memorizing the order of the items would facilitate the retrieval of order information, since the sense making processes involved in impression formation would disrupt the sequence of the behaviors in the studied list. Results apparently support this hypothesis, given that participants that memorized the order of the information did better in retrieving order information, than participants that formed impressions. This finding, together with item memory, provided the first double dissociation pattern of this set of experiments, where impression formation conditions outperformed the memorization conditions in item memory, and the opposite effect was true for order information, where the memorization conditions lead to better memory for order.

However, this is an illusory dissociation since the retrieval of information based on memory for order was higher in the memorization conditions compared to the impression formation conditions, but only in free recall, not in ordered recall. Thus, such dissociation only happened when people were accessing memory in a spontaneous way, that is, when participants were instructed to free recall the behaviors. But when participants were explicitly asked to recall the information accessing order information, impression formation participants were as good retrieving (or using) order information as the ones that memorized the information. This shows that impression formation does not seem to use order information while free recalling information from memory, but it is able to access and use such information if necessary, that is, when participants were asked to recall the information attempting to follow the original studied order of the stimulus list. This finding, together with the last two experiments seems to suggest that impressions are indeed able to represent order information, even in conditions where order information is meaningless to make sense about the target.

The main effect of the recall mode indicates that when participants were asked to retrieve information in order they performed better in the memory for order measure, or putting it better, retrieved information more based on order information. Yet, the interaction between the recall mode and the processing goals is extremely informative. The main effect of the processing goal reported earlier for order information was completely driven by the free recall conditions. That means that, after all, the double dissociation that was found for the first time in this experiment in terms of order and item information across processing goals, is an artifact of the recall strategy that was used to access the memory structure, since impression formation's ability to use order information that seems hindered in the free recall conditions, is not different from the memorization conditions in the ordered recall conditions. This seems to suggest that, indeed, even in such conditions, impressions represent order information. In fact, with this finding it is possible to state that evidence seem to suggest that person impressions represent order information but only seem to use it, at least in such experimental settings, when specifically asked to do so.

Free recall involves people naturally remembering information they have previously encountered. Ordered recall involves people remembering information in a constrained way, that is, participants have to report information in a specific order. When people free recall the information, it is expected that information is retrieved making use of a chaining mechanism, based on the associations formed at encoding. For impression formation conditions, such recall strategy facilitates the retrieval of item information, given the organization built at encoding. However, regarding order information, given that the chaining built at encoding was expected to be independent from the temporal order, when impression formation participants free recall information there is no reason to rely on temporal chaining. Data was in line with these hypotheses. For the memorization processing goal, given that it does not promote such organized memory structure, it is expected to result in poor memory for item information. However, regarding order information, such processing goal was assumed to represent information simply associating items in contiguous positions, and thus promoting memory for order information. Data was in line with these hypotheses.

When people recall the information by order, participants are constrained to retrieve information in a specific way. If the association that were formed at encoding follow the temporal order information, then people should simply follow such associations to retrieve information by order. However, if the associations that were formed at encoding are independent of the temporal order information, then people should not be able to retrieve order information by the chaining mechanism and furthermore, should retrieve less information. For the memorization conditions data is in line with such predictions, given that results are similar to the ones obtained in free recall, both for item and order memory. For impression formation processing goal conditions results were surprising. On the one hand, the ordered recall strategy did not interfere with the ability to retrieve item information and, on the other hand, the ordered recall strategy that was sought to disentangle the conditions where associations built at encoding were independent from order (impression formation), from the conditions where associations built at encoding followed temporal order (memorization), showed that impression formation participants were as good as memorization participants accessing and using order information (memory for order). Thus, when people recall information by order, the chaining that was used at encoding when people formed impressions did not interfere with order retrieval.

Summing up, in this third experiment we predicted and found, for the first time, the dissociation of order and item memory across processing goals. However, such dissociation was only found in free recall, that is, when people retrieve information without any constraints. When participants were asked to recall the information in the order it was studied, the dissociation disappeared. This finding is intriguing for the chaining hypothesis, given that order seems to be represented when people form impressions and build associative networks representing persons. This order information can (or cannot, depending on the retrieval strategies) be accessed during retrieval, but, nevertheless, the representation of order seems to take place in person impressions. According to Hamilton and colleagues (1980a, 1980b), in a multi-trait context, people represent the information grouped, or clustered by trait. Even the complete association model (Hamilton, et al, 1989) posits that associations are built between all types of information within the trait cluster, but no associations are assumed to be developed between items in different traits. Thus, again, forming an impression could be grouping the traits together in memory in a way that promotes the preservation of order information. However, according to Klein and colleagues' elaborative-encoding account (1990) of impression formation, items' representation is independent of the trait categories and the trait cluster found in recall protocols is a retrieval phenomenon, rather than an illustration of the representational structure. The personality trait is not used as a meaningful representational and organizational cue. Therefore, if that would be the case, according to

Klein and collaborators (1990), the impression formation ability to retrieve order information would be a retrieval phenomenon. As such, an experiment with a more dynamic setting is necessary, with incongruent information in the stimulus material, as a way to increase the amount of inter-item associations, to test if the promotion of inter-item associations impacts the ability to represent and retrieve order. Plus, adding incongruent information increases the difficulty of the task, which raises the likelihood of disturbing order representation.

4. Experiment 4

Now that we seem to have established that when people form impressions order information seems to be represented in the person memory structure that is built to represent a given person, we are ready to try to better understand the underlying representational assumptions of order information in person memory. We started this endeavor with the event memory proposal for temporal coding of units of events, as well as the chaining hypothesis, as the most plausible and natural theoretical accounts from where to derive hypotheses regarding the representation of order information in person memory. However, findings from previous studies seem to suggest that the event memory proposal is inadequate to account for order representation in person memory. Also, previous studies have left us unsure about the associative-based representation of order information, since if some findings bear support to the chaining assumptions, some others seem to be at odds with the way order information is represented in the associative chaining models. As such, from this experiment onwards we are attempting to better understand the representation of order information in person memory, trying to test the chaining assumptions for a proper representation of order in person memory. If the first three studies represented variations of the stimulus material (multiple/single targets; single/multiple traits) in an attempt to reach an appropriate experimental setting to study order information representation and retrieval in person memory, from the present experiment onwards we are trying to directly interfere with the processes that are hypothesized to underlie the representation and retrieval of information in general, and order information in particular, to better understand the role of order information in person memory.

To test the chaining assumptions, in this fourth experiment we introduced incongruent information in our stimulus material. The idea was that, according to the prevalent explanations of the incongruency effect, when incongruent information is present in the stimulus material, the processes involved in the sense making of impression formation trigger an attempt to solve the inconsistency caused by the expectancy violating information, to reach a coherent representation of the target person. One of the consequences of such inconsistency resolution processes is that the amount of associations between the items represented in the associative network representing the target increase. In fact, given the unexpected nature of incongruent information, in an attempt to explain such information, incongruent items remain longer in working memory, being compared to the other items already encoded that are brought to working memory in an attempt to make sense about the target. The output of the extended presence of incongruent information in working memory is that this information will end up establishing more associations to other items in the memory structure. As such, when incongruent information is present, a more densely associated network of items is stored in memory representing the target person.

With this experiment we intended to introduce incongruent information to increase the associative density of the network The rationale is that if order would be represented by associations between items in successive positions, than this increase in the amount of inter-item associations, caused by the incongruent information, would disrupt the representation of order information in the person memory structure.

4.1. Research question

With this experiment we were interested in starting to test whether order information representation in person memory was based on associations between successive items in an associative chain. As such, we wanted to know whether the increment of the amount of inter-item associations in the person memory structure, that is likely to occur as a consequence of the presence of incongruent information, would result in the impairment of the representation of order information. Then, if order information would be represented associatively in person memory, then the increase of the inter-item associative density should disrupt the ability to encode and access this information in the person memory structure representing the target. If this is the case, then the performance in the order information measure should be affected by the presence (or absence) of incongruent information in the stimulus material and, consequently, be sensitive to the amount of inter-item associations in memory.

In fact, if order information is sensitive to the increase in the amount of inter-item associations in memory, then order information should have an associative representational base. Differently, if order information is not affected by the increase in the amount of inter-item associations in memory, then the representation of order information should be independent of the associations between the items, and, as such, should not be associative in nature.

According to the explanation of the incongruency effect that relies on the increased amount of inter-item associations that result from the comparison of the unexpected item with the previously known items describing the target, since incongruent information is unexpected and does not fit the overall impression, people engage in a process to try to resolve the inconsistency. This means that incongruent items will be compared (to a greater extend) to the already known items about a target. As a consequence of this attempt to solve the inconsistency, incongruent information will remain for a longer period in short-term memory, where it is compared to the other encoded information. This process results in the development of associations between incongruent items and other already known items. The resultant associative network is, therefore, more dense, with an increased amount on inter-item associations (incongruent-congruent associations).

If order is encoded associatively, then the ability to access order information should be impaired by increasing the amount of associations in memory. If order is encoded independently of the associations between items, then it should make no difference whether the associative network change in the density of inter-item associations.

4.2. Hypotheses

The hypotheses for this experiment are divided in two parts. The first, referring to the congruent lists (that is, lists that replicated previous experiments in the sense that had only behaviors illustrative of one personality trait, plus irrelevant behaviors – these lists are called congruent since the only personality trait is congruent with the expectancy that was provided to participants at the beginning of the study phase). The second, describing the incongruent lists that are new to this study.

For the congruent lists, we expected, like in previous experiments, that (i) memory for the item information would be better under impression formation goal conditions, than under the memorization goal conditions. Moreover, we expected that (ii) memory for item information would be better for congruent information, compared to irrelevant information. Even further, we expected that (iii) this last finding should be present only for the impression formation conditions, and not for the memorization of order conditions. All these effects were the consequence of the organizational advantage provided by the sense-making processes involved in impression formation, where information is organized in the memory structure and meaningful information is more carefully attended to, resulting in a better detailed representation.

On the other hand, we expected that (iv) in terms of memory for order, the pattern of results obtained in experiment 3 should be replicated, since this conditions are equivalent to the setting used in experiment 3. There was no incongruent information that would disrupt the impression formation ability to retrieve order information in the ordered recall conditions, that is, in the conditions where participants were instructed to retrieve information in the sequence the information was studied.

For the incongruent lists, we expected, also like in previous experiments, that (i) memory for the item information would be better under impression formation goal conditions, than under the memorization goal conditions. Moreover, we expected that (ii) memory for item information would be better for incongruent and congruent information, compared to irrelevant information. Even further, we expected that (iii) this last finding should be present only for the impression formation conditions, and not for the memorization of order conditions. Furthermore, we expected (iv) that an incongruency effect would be found, were incongruent information was better recalled, compared to the congruent and irrelevant information. These findings should be the consequence of organizational processes involved in impression formation, together with the processes involved in the inconsistency resolution.

On the other hand, if order information was represented in a chain of associations between items in successive positions, we expected that (v) the pattern of results obtained in experiment 3 should not be obtained since the incongruent information would disrupt the impression formation ability to retrieve order information in the ordered recall conditions, that is, in the conditions where participants were instructed to retrieve information in the sequence the information was studied. The extra associations that characterize the memory structure that results from processing and encoding incongruent information should interfere with the ability to retrieve order information. If the interactive pattern between processing goal and recall mode is not found, with the impression formation processing goals failing to facilitate the retrieval of order information, both in the ordered recall and in the free recall conditions, then the conceptualization of order information representation by means of associations between items is strengthen. However, if such interaction is found, than it should be illustrative that order information representation and use takes place irrespectively of the inter-item associations that are developed at encoding.

4.3. Method

Participants

177 undergraduate students from the University of California, Davis (UC, Davis, USA), participated in the experiment in exchange for course credit.

Design

Participants were randomly assigned to the cells of a 2 (processing goals: impression formation set vs. memorization of order set) X 4 (expectancy: intelligent, friendly, stupid, and unfriendly) X 2 (list congruency: incongruent vs. congruent) X 2 (recall mode: free recall vs. ordered recall) factorial design.

Material[20]

The material used in this study consisted, again, in a subset of the behavioral descriptions pre-tested by Fuhrman and colleagues (1989). For this study, a total of 36 behavioral descriptions performed by a single target were selected. There were 12 irrelevant, or neutral, behavioral descriptions. The remaining 24 behaviors either referred to the intelligent-stupid dimension, or to the friendly-unfriendly dimension. As such, we had 6 intelligent behaviors, 6 stupid behaviors, 6 friendly behaviors and, finally, 6 unfriendly behaviors. There were congruent and incongruent lists. The congruent lists had the 6 behaviors illustrative of one of the four personality dimensions (intelligent, stupid, friendly or unfriendly) and 12 irrelevant behaviors. The incongruent lists had 6 behaviors congruent with a prior expectancy, 6 behaviors incongruent with that same expectancy and, finally, 6

20 See *Appendix IV – Experiment 4: Stimulus Material* for the entire set of stimulus material from experiment 4.

irrelevant behaviors. For example, for the expectancy “the target is intelligent”, a congruent list would have 6 intelligent behaviors and 12 irrelevant behaviors, whereas an incongruent list would have 6 intelligent, plus 6 stupid and 6 irrelevant behaviors. It should be noted that the behaviors that are incongruent regarding one expectancy, are congruent in respect to the opposite expectancy, and vice-versa. This is, the stupid behaviors that are incongruent for the intelligent expectancy, are congruent for the stupid expectancy, and vice-versa, for the intelligent behaviors. Each list has 18 behaviors and there were 6 different lists (intelligent list, stupid list, friendly list and unfriendly list, and then 2 mixed (i.e., incongruent) lists, that is, a list with intelligent and stupid behaviors, and a list with friendly and unfriendly behaviors).

Procedure

The procedure adopted in this study was generally the same as the one used in previous experiments. Participants were informed[21] that they would take part in a study about impression formation (or in a study about the memorization of order). At the beginning of the study phase participants were presented with a paragraph describing how the friends of the target describe him. These paragraphs provided four different expectancies. The target was seen by his friends either as intelligent, stupid, friendly, or unfriendly. Then, participants would study the stimulus list. Each one of the 18 behaviors was presented automatically during 6 seconds in a computer screen. The behaviors were presented in a random order. Depending on the experimental condition these 18 behaviors referred to one of the six lists of behaviors (intelligent, stupid, friendly, unfriendly, intelligent + stupid, and friendly + unfriendly). Participants performed, then, a distracter task. Lastly, they were either asked to free recall the behaviors that were presented at the study phase, or to recall the behaviors in the order they were presented in the stimulus list.

21 For the entire set of instructions, see *Appendix IV – Experiment 4: Instructions*.

Dependent measures[22]

Item memory

Proportion of free recalled behaviors in relation to the total of behaviors presented in the stimulus list.

Order memory

Index that computes, between 0 and 1, how correct the recalled sequence resembled the original stimulus sequence.

4.4. Results[23]

The item memory analysis is divided in two sections, the first where we looked exclusively at the congruent and irrelevant items, and the second, where we looked at all the information, congruent, irrelevant and incongruent items. Such division is peremptory since some of the lists that constituted the stimulus material (4 out of 6) had no incongruent information (only congruent and irrelevant items) and the other half had incongruent information (i.e., incongruent, congruent and irrelevant items). Furthermore, given that the net amount of irrelevant items is not the same in the lists with and without incongruent information, we relied on proportions instead of absolute values, because only proportions would allow the direct comparison across information types. The order memory analysis is presented collapsed across congruent and incongruent conditions given that no differences exist between the conditions.

22 See *Appendix IV – Experiment 4: Dependent Variables* for the detailed computation of the dependent variables.

23 See *Appendix IV – Experiment 4: Test of Normality and Homogeneity of Variances* for the tests of normality and homogeneity of variances.

Item Memory: congruent and irrelevant items *(for the lists that had no incongruent information)*

The item memory proportions were entered in a 2 (processing goals: impression formation set vs. memorization of order set) X 2 (list congruency: incongruent vs. congruent) X 2 (recall mode: free recall vs. ordered recall) factorial ANOVA, with a repeated measures factor – item type – for the type of items recalled, that can either be congruent or irrelevant.

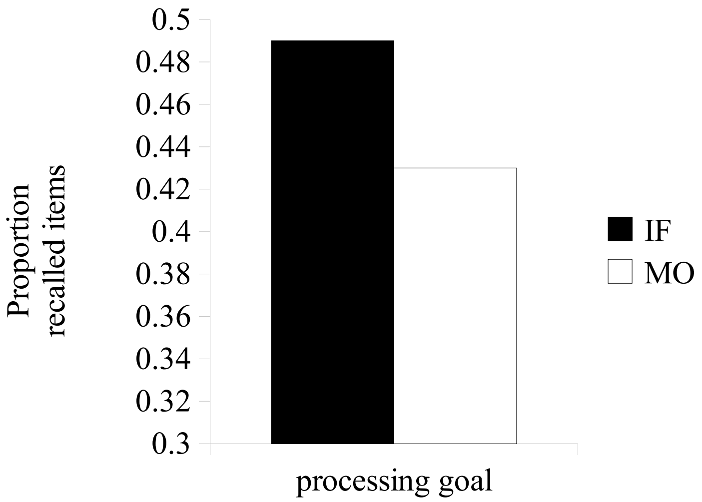


Figure 16: Proportion of recalled items as a function of the processing goal.

Data indicates, as predicted, a main effect (Figure 16, above) of the processing goals, $F\ (1,158) = 5.96$, $p < 0.02$, with impression formation participants recalling more behaviors ($M = 0.49$), than the memorization of order participants ($M = 0.43$).

Furthermore, there was a main effect (Figure 17, bellow) of the item type, $F\ (1,158) = 27.09$, $p < 0.00$, where participants recalled more congruent items ($M = 0.50$) than the irrelevant ones ($M = 0.41$).

Additionally, data indicates an interaction (Figure 18, bellow) between the processing goals and item type, $F\ (1,158) = 9.15$, $p < 0.00$, where it is shown that the congruent advantage is due to the impression formation conditions, where participants recalled significantly more items (M = 0.56) than in the memorization of order conditions (M = 0.45) (planned comparison – congruent items: IF vs. MO: t (1,158) = 3.57, p < 0.00, one-tailed). Regarding the irrelevant items, there is no difference between the impression formation (M = 0.41) and memorization of order conditions (M = 0.41).

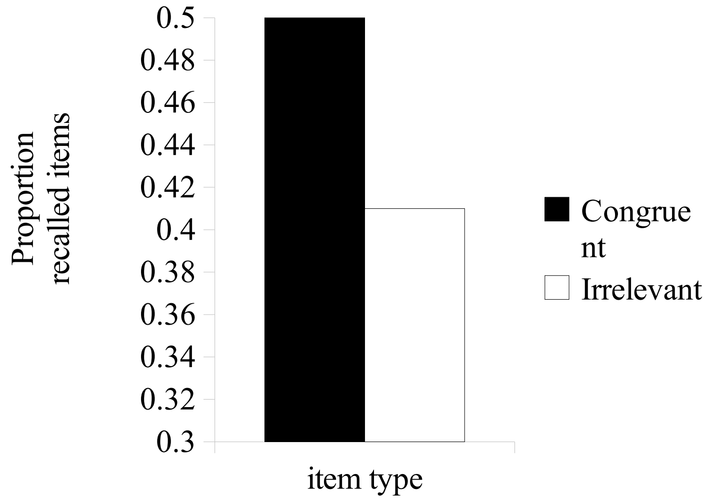


Figure 17: Proportion of recalled items as a function of the item type.

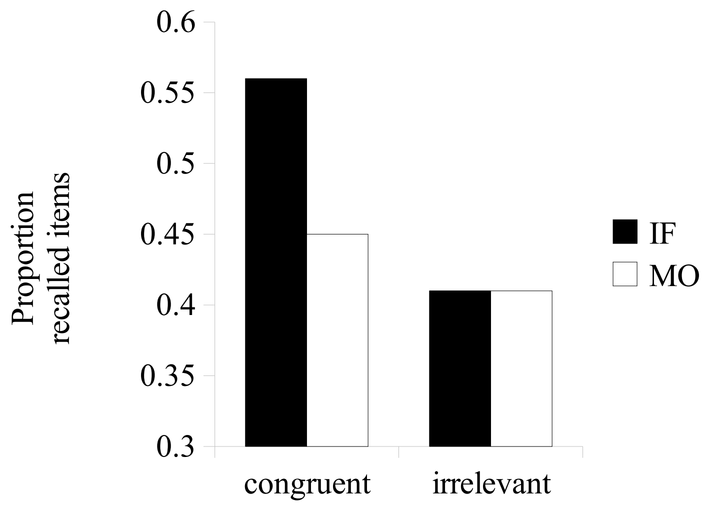


Figure 18: Proportion of recalled items as a function of the processing goal and item type.

Item Memory: congruent, incongruent and irrelevant items *(for the lists that had incongruent information, that is, the incongruent lists)*

The item memory proportions were entered in a 2 (processing goals: impression formation set vs. memorization of order set) X 2 (recall mode: free recall vs. ordered recall) factorial ANOVA, with a repeated measures factor – item type – for the type of items recalled, that in this analysis has three levels and can either be congruent, incongruent or irrelevant.

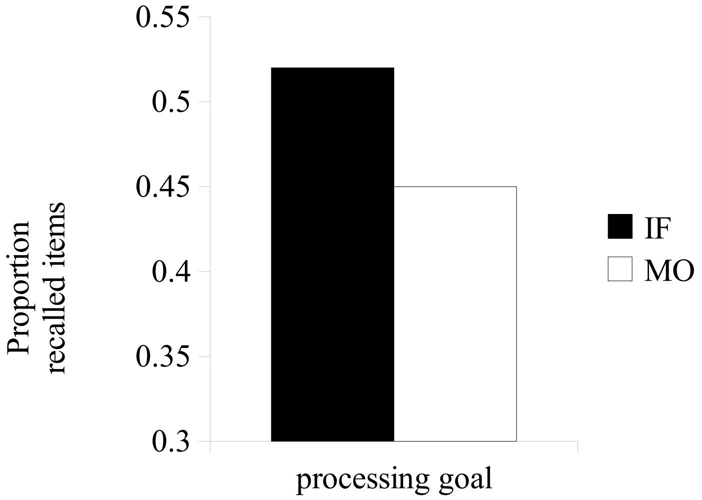


Figure 19: Proportion of recalled items as a function of the processing goal.

Results show, as predicted, a main effect (Figure 19, above) of the processing goals, F (1,75) = 5.70, $p < 0.02$, with impression formation participants recalling more behaviors (M = 0.52), than the memorization of order participants (M = 0.45).

Furthermore, there was a main effect (Figure 20, bellow) of the item type, F (2,150) = 5.94, $p < 0.00$, where participants recalled more congruent items (M = 0.51) and incongruent items (M = 0.52) than the irrelevant ones (M = 0.43).

Additionally, data indicates an interaction (Figure 21, bellow) between the processing goals and item type, F (2,150) = 6.39, $p < 0.00$, where it is shown that the pattern of results found for the item type main effect is totally driven by the impression formation conditions.

For the impression formation conditions, incongruent items (M = 0.59) are better recalled than the congruent (M = 0.56) and irrelevant items (M = 0.42) together (planned comparison, for IF, I vs C + Ir: t (75) = 3.06, $p < 0.00$, one-tailed). Although it seems that there is an incongruency effect, it does not reach statistical significance (planned comparison, for IF, C vs I + Ir: t (75) = 1.70, $p < 0.09$, one-tailed). There is no difference between incongruent (M = 0.59) and congruent items (M = 0.56) for the impression formation conditions (planned comparison, for IF, I vs C: t (75) < 1). For the memorization of order processing goal conditions, there is no difference across type of information (congruent, M = 0.46; incongruent, M = 0.44; irrelevant, M = 0.45).

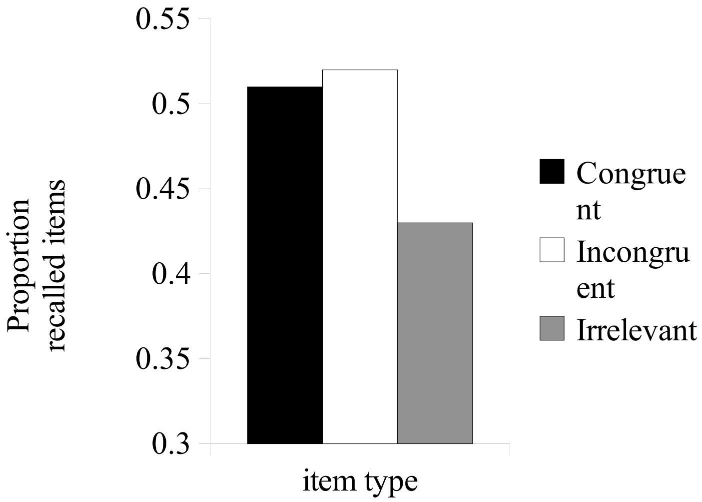


Figure 20: Proportion of recalled items as a function of the item type.

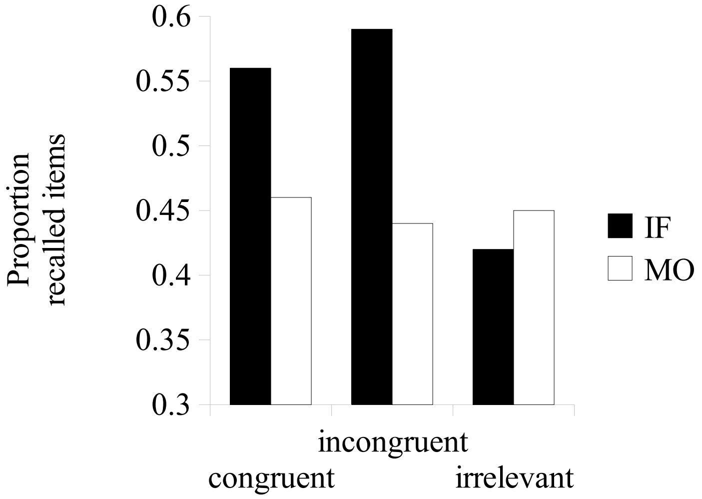


Figure 21: Proportion of recalled items as a function of the processing goal and item type.

Order Memory

The memory for order index was entered in a 2 (processing goals: impression formation set vs. memorization of order set) X 2 (list congruency: incongruent vs. congruent) X 2 (recall mode: free recall vs. ordered recall) factorial ANOVA.

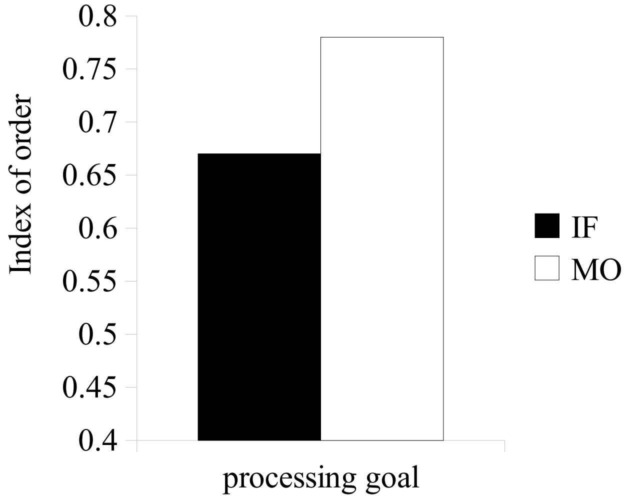


Figure 22: Index of order (0-1) as a function of the processing goal.

This analysis reveals a main effect (Figure 22, above) of the processing goals, *F*

(1,169) = 11.40, $p < 0.00$, where the memorization of order participants ($M = 0.78$) had better memory for the order than the impression formation participants ($M = 0.67$).

Additionally, there was a main effect (Figure 23, bellow) of the recall mode, F (1,169) = 7.07, $p < 0.01$, where participants that recalled the information attempting to keep track of order performed significantly better in order memory ($M = 0.76$), compared to the ones that freely recalled the information ($M = 0.68$).

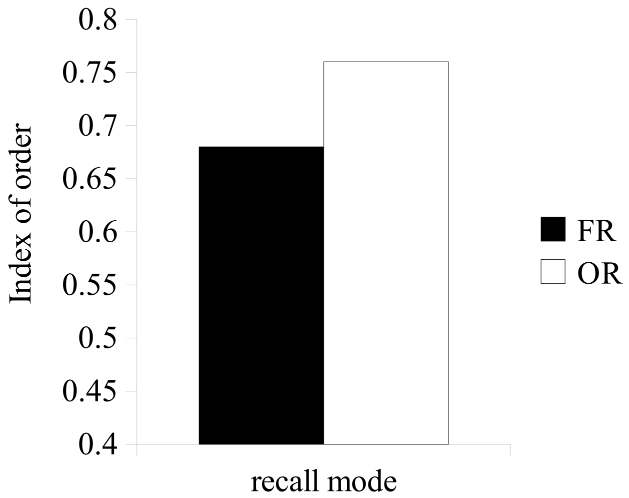


Figure 23: Index of order (0-1) as a function of the recall mode.

Of more interest is the fact that there is an interaction (Figure 24, bellow) between processing goals and recall mode, F (1,169) = 5.19, $p < 0.02$. In free recall, impression formation participants ($M = 0.59$) were significantly worse (planned comparison: t (169) = 3.96, $p < 0.00$, one-tailed) at retrieving information using order information compared to the memorization of order participants ($M = 0.77$), whereas in ordered recall, that is when specifically instructed to recall the information keeping track of order, impression formation participants ($M = 0.75$) were as good (planned comparison: t (169) < 1, p = 0,22, one-tailed) following the order in which the information was presented at the study phase, as the memorization of order participants ($M = 0.78$). The planed contrast between the impression formation conditions in free recall and ordered recall, $t\ (169) = 3.41$, $p < 0.00$, one-tailed, also indicates that impression formation participants performance in using order information increased from the free recall ($M = 0.59$) to the ordered recall ($M = 0.75$) conditions. There was no effect whatsoever of the list congruency (or item type).

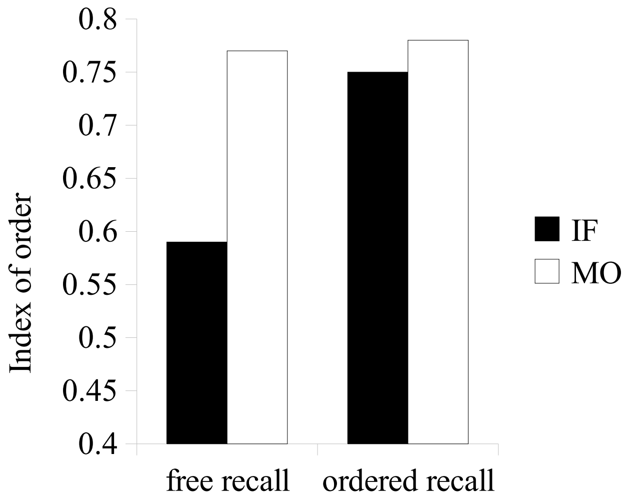


Figure 24: Index of order (0-1) as a function of the processing goal and recall mode.

4.5. Discussion

Results from the fourth experiment indicate that item information was better retrieved for congruent (and incongruent) items, compared to the irrelevant items. Furthermore, item information was better retrieved in the impression formation conditions, compared to the memorization of order conditions, both when considering congruent and incongruent lists. However, the difference between processing goals was totally driven by congruent (and incongruent) items, since there was no difference across processing goals for irrelevant items. In fact, the impression formation advantage in recalling items only took place for congruent (or congruent together with incongruent) information, and not for irrelevant information. That is, there was no difference across processing goals for irrelevant information. The inclusion of incongruent information basically replicates the finding for congruent information, that is, people that formed impressions recalled more incongruent items than the ones that memorized the order of the information. Apparently an incongruency effect was found, but did not reach statistical significance. These findings replicate data from previous experiments, extending them to settings with incongruent information.

Order information, on the other hand, perfectly replicated the findings from the experiment 3, that is, order information was better retrieved and used when participants memorize the order of the information, compared to when participants have formed impressions. Furthermore, this finding was again qualified by the recall mode, with the pattern just described being true only when participants free recalled the information, and not when participants recalled information keeping track of order. The presence of incongruent information did not change such pattern of results and the use of order information, thus, analyses of order memory were presented aggregating the congruent and incongruent information.

We expected that, for congruent and incongruent lists, impression formation would facilitate the recall of item information, as a consequence of the organizational processes underlying impression formation. Results support this hypothesis. Participants instructed to form impressions recalled more behaviors, than participants instructed to memorize the order of the information. We replicate, once more, previous experiments, suggesting that the processes of impression formation organize information in memory and such organization facilitates the recall of the content of such memory structure. We also expected that incongruent (and congruent) information would be more easily recalled, than the irrelevant information, for the participants that formed impressions. Results only partially support this hypothesis. Participants that were instructed to form impression recalled indeed more congruent (and incongruent) behaviors, than irrelevant behaviors. However, the incongruency effect did not reach statistical significance. This set of findings is in line with the explanation of person impressions as memory structures that are a consequence of organizational processes that aggregate information in memory, as well as with the inconsistency resolution processes that result in the development of inter-item associations in an attempt to explain the unexpected information. As such, the typical pattern of results that has been obtained in previous experiments, together with the present experiment, can be accounted by an associative network person memory structure. People that form impressions seem to be able to represent and access order information, although they do not seem to use order spontaneously. But when specifically asked to report the content of memory in the order the information was perceived, people that formed impressions are able to do so, which suggests that order representation is independent of chaining.

If order information would be represented in an associative chain in the person memory structure, we expected that for incongruent lists, the pattern of result obtained in experiment 3 (impression formation processing goals facilitating the retrieval of order information in the ordered recall conditions, but not in the free recall conditions) should disappear, since the representation of order would be compromised by the competitive associations present in the associative network memory structure. However, if order would be represented in the person memory structure independently of the chain of associations between the successive items, then the pattern of results obtained in experiment 3 should be replicated, even in the presence of incongruent information (and its consequent more densely associated network). If order is represented independently of associations, then the increment in the amount of associations should not affect the ability to represent and access order information. Results are in line with the last hypothesis. That is, and perfectly replicating experiment 3, in free recall, participants that formed impressions used less order information to retrieve items, compared to the memorization of order participants. This difference disappears in ordered recall, where participants instructed to form impression performed as well as the participants instructed to memorize the order of information. That is, participants' ability to retrieve and use order information in the impression formation conditions was not hindered by the presence of incongruent information, which suggests a non-associative representation of order information in person memory.

Summing up, in this fourth experiment we predicted the dissociation of order and item memory across processing goals. Results are in line with the predictions, replicating experiment 3. Furthermore, the existence of incongruent information, and its consequent increase in the amount of inter-item associations, had no impact in order information retrieval and use. In fact, it is irrelevant to have incongruent information, given that the ability to retrieve order information remains unaffected when people form impressions in the presence of incongruent information. Thus, the natural chaining process that occurs while people form impressions (associating items among themselves) does not hinder the ability to retrieve order. Therefore, impression formation participants seem to be retrieving order independently of such chaining process.

5. Experiment 5

The findings from the previous experiment seem to indicate that order information is not represented by means of an associative chain between successive items in the person memory structure. At least, increasing the amount of inter-item associations in the network had no (negative) impact on the ability to retrieve and use order information from the person memory structures. However, those are preliminary findings and, thus, insufficient to draw the conclusion that the representation of order information is not based on associations between items. This is especially so given that some interpretations of the incongruency effect are not based on the increased amount of inter-item associations, and the fact that the incongruency effect failed to reach statistical significance.

With the present experiment we intended to further dive into the testing of the theoretical possibility of order information being represented in memory associatively. As such, in this fifth experiment we introduce an array of different impression formation processing goals to attempt to promote different types of associations in the person memory structure representing the target. We were interested in the consequences of these different associations in the representation of order information. The idea is that, following the last experiment, if the representation of order is associative in nature, then the promotion of specific associations in person memory, should impact negatively the ability to retrieve and use order information. This ability should be, thus, hindered by the associations that are established at encoding.

5.1. Research question

The research question that orients this experiment is, still, whether order information is represented in person memory by means of associations between items in successive positions. Specifically, and differently from the previous experiment, in this fifth study we decided to manipulate directly some of the associations that are built during encoding to then evaluate their impact in a subsequent task that demands for the retrieval of order information. We want to know if promoting specific associations in memory hinders order memory. Moreover, we are interested in the order memory consequences of different associations being built at encoding. Do all associations that can be built at encoding equally impair the representation of order information? If the representation of order information follows the associative chaining proposal, then participants ability to retrieve and use order information should be affected by the comparisons that were made at encoding (and the associations that such comparisons implied) and, furthermore, different comparison conditions should result in different associative network patterns which, in turn, should impair order memory differently. On the other hand, if order information is not represented using an associative chain, then these comparisons should have no impact in the way participants are able to access, retrieve and use order information from the memory structure.

Apart from the standard impression formation condition, we implemented three more impression formation conditions. In one condition participants were asked to think about similar behaviors (i.e., when reading an intelligent behavior, participants should attempt to think about another intelligent behavior). This condition was named *impression formation, compare with similar*. In one other condition, participants were asked to think about different behaviors (i.e., when reading an intelligent behavior, participants should attempt to think about either a friendly, adventurous or extraverted behavior). This condition was named *impression formation, compare with different*. Finally, in the third condition, participants were asked to think about the previous behavior (i.e., when reading a behavior, participants should attempt to think about the behavior just presented). This condition was named *impression formation, compare with previous*. These impression formation instructions were implemented as a way to promote the development of specific inter-item associations, that were expected to result in different patterns of associative links in the memory structure. The different patterns of inter-item linkages in memory should differently impact the ability to represent and retrieve order information.

So, summing up, is order information sensitive to a manipulation that will affect the amount and the nature of the inter-item associations in the person impression? If order information is encoded independently of the associations between items, then it should not be affected by the amount or nature of the comparisons that are done and the associations that are built during encoding. Item information, on the contrary, should be positively impacted by comparisons that are ecological, and negatively impacted by comparisons that do not promote the associations that are normally built during impression formation.

With this experiment we intend to further assert the associative component of item information representation and, simultaneously, the non-associative representation of order information in person impressions.

5.2. Hypotheses

We expected that (i) memory for the item information would be better for the impression formation goal conditions, compared to the memorization of order goal conditions. This was true for the standard impression formation condition, as well as to the other impression formation conditions, where participants were instructed to compare specific behaviors while forming an impression about the target person. It should be noted that one of the impression formation processing goal conditions was not very ecological. That is, in one of the impression formation conditions, the comparison that participants were asked to do was rather unusual for the sense making purpose of forming an impression – comparing the behaviors with a behavior from a different trait. Overall, the effect that was expected in terms of item memory was informed by the person memory associative network structure and the organizational processes that are used to build such memory structure during the formation of person impressions.

As for order memory, we expected (based on the chaining assumptions) that (ii) the memory for the order information pattern that was found in experiment 3, and replicated in experiment 4, should not be observed given the extra associations that were created at encoding by the impression formation comparison conditions. These extra associations should disrupt the ability of impression formation to represent and retrieve order information in the ordered recall conditions. If order information is not represented associatively, we should be the able to obtain evidence of an associative-independent representation of order information. That is, if order information is not represented by means of inter-item successive associations, then the pattern of results obtained in previous experiment should also be obtained here, and impression formation should be able to retrieve order information when specifically instructed to do so in the ordered recall conditions.

5.3. Method

Participants

159 undergraduate students from the University of California, Davis (UC, Davis, USA), participated in the experiment in exchange for course credit.

Design

Participants were randomly assigned to the cells of a 5 (processing goals: impression formation set; impression formation – compare with similar set; impression formation – compare with different set; impression formation – compare with previous set; memorization of order set) X 2 (recall mode: free recall vs. ordered recall) factorial design.

Material[24]

The material used in this study consisted in a subset of the behavioral descriptions pre-tested by Fuhrman and colleagues (1989). For this study, 24 behavioral descriptions were selected, describing four different personality dimensions (intelligent, friendly, adventurous, and extraverted) and one single target. As such, the target performs 6 behaviors from each of the four personality traits, in a total of 24 behaviors.

Procedure

The procedure adopted in this study was generally the same as in previous experiments. Initially, participants were informed[25] that they would take part in a study about impression formation (or in a study about the memorization of order). More specifically, one fifth of the participants were instructed to memorize the order, and the remaining four fifths were instructed to form impressions in four different ways. That is, after being instructed to form impressions, one group proceeded without further instructions (the typical impression formation condition) and for the remaining three fifths of the participants, after the initial impression formation instruction participants were instructed to either think about similar behaviors when reading the stimulus list (i.e., when reading and intelligent behavior to think about another intelligent behavior), or to think about different behaviors (i.e., think about a friendly, adventurous or extraverted behavior while reading an intelligent behavior), or, finally, to think about the previous behavior that was just presented in the stimulus sequence. Participants were instructed to compare only a subset of 8 behaviors in the entire sequence of 24 behavioral descriptions. Since the behaviors, as well as the comparison instructions, were presented in random order, to assure that participants would always have a behavior to

24 See *Appendix V – Experiment 5: Stimulus Material* for the entire set of stimulus material from experiment 5.
25 For the entire set of instructions, see *Appendix V – Experiment 5: Instructions*.

compare to, at the beginning of any given random sequence, the same set of 4 behaviors appeared initially, portraying the four personality trait dimensions. In this group of four behaviors, the sequence of behaviors was also randomly determined. As such, for example, if in the fifth position of the stimulus list participants had a intelligent behavior with the instruction to compare with a similar behavior, there was always an intelligent behavior to compare to that was presented before. It should be noted that in the total of 24 behaviors in the list, 2 behaviors from each of the four personality trait dimensions were always accompanied (in the comparison conditions) by the comparison instructions. Participants studied the 24 behaviors of the stimulus list. Each one of the 24 behaviors was presented automatically during 6 seconds in a computer screen. 20 behaviors were presented in a random order. Then, participants performed a distracter task. Lastly, they were either asked to free recall the behaviors that were presented at the study phase, or to recall the behaviors in the order they were presented in the stimulus list.

Dependent measures[26]

Item memory

Proportion of free recalled behaviors in relation to the total of behaviors presented in the stimulus list.

Order memory

Index that computes, between 0 and 1, how correct the recalled sequence resembled the original stimulus sequence.

26 See *Appendix V – Experiment 5: Dependent Variables* for the detailed computation of the dependent variables.

5.4. Results[27]

Item Memory

The item memory proportions were entered in a 5 (processing goals: impression formation set; impression formation – compare with similar set; impression formation – compare with different set; impression formation – compare with previous set; memorization of order set) X 2 (recall mode: free recall vs. ordered recall) factorial ANOVA.

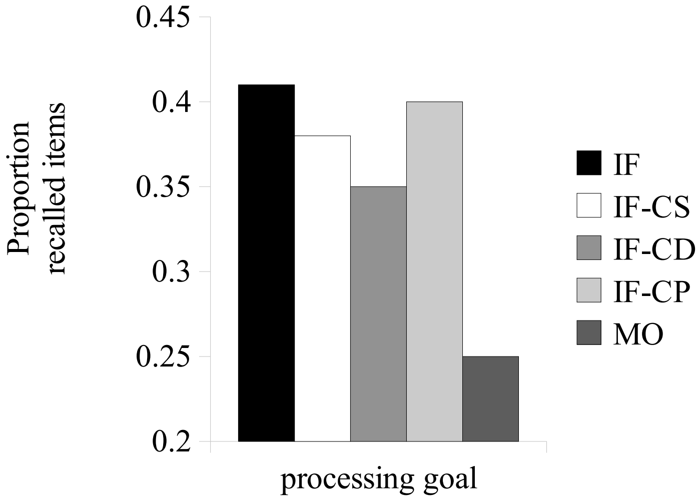


Figure 25: Proportion of recalled items as a function of the processing goal.

Results show that, as predicted, and again replicating the previous experiments, a main effect (Figure 25, above) of the processing goals, F (4,149) = 7.78, $p < 0.00$, with the various impression formation conditions recalling more behaviors (impression formation: M = 0.41; impression formation – compared with similar: M = 0.38; impression formation – compared with different: M = 0.35; impression formation – compared with previous: M = 0.40), than the memorization of order conditions (M = 0.25). Post-hoc tests revealed no differences between the impression formation conditions.

27 See *Appendix V – Experiment 5: Test of Normality and Homogeneity of Variances* for the tests of normality and homogeneity of variances.

Order Memory

The memory for order index was entered in a 5 (processing goals: impression formation set; impression formation – compare with similar set; impression formation – compare with different set; impression formation – compare with previous set; memorization of order set) X 2 (recall mode: free recall vs. ordered recall) factorial ANOVA.

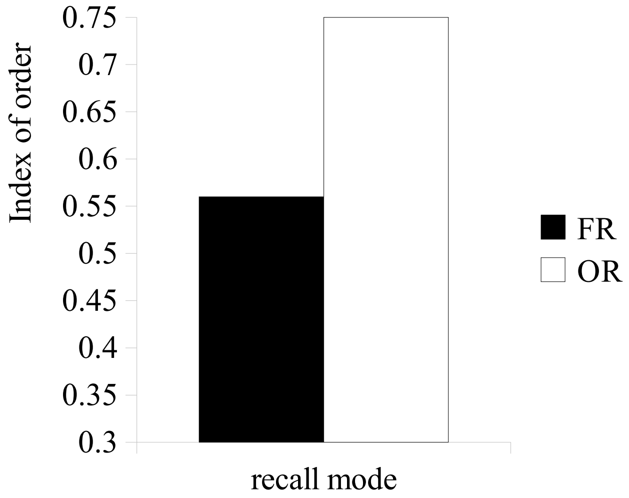


Figure 26: Index of order (0-1) as a function of the recall mode.

This analysis reveals a main effect (Figure 26, above) of the recall mode, F (1,148) = 30.16, $p < 0.00$, where the ordered recall conditions performed significantly better ($M = 0.75$) in the order memory measure (i.e., information was retrieved using order information), compared to the free recall conditions ($M = 0.56$).

This main effect was qualified by an interaction (Figure 27, bellow) with the processing goals, F (4,148) = 1.28, $p < 0.09$. Of interest is the replication of the previous pattern of results. In free recall, impression formation participants ($M = 0.54$) were marginally worst (planned comparison: t (1,148) = 1.38, $p < 0.08$, one-tailed) using order information compared to the memorization of order participants ($M = 0.64$), whereas in ordered recall impression formation participants (M = 0.75) were as good (planned comparison: t (148) < 1) following the order in which the information was presented at the study phase, as the memorization of order participants (M = 0.72). Moreover, the planed contrast between the impression formation conditions in free recall and ordered recall, t (148) = 8.20, p < 0.00, one-tailed, also indicates that impression formation participants performance in using order information increased from the free recall (M = 0.54) to the ordered recall (M = 0.75) conditions.

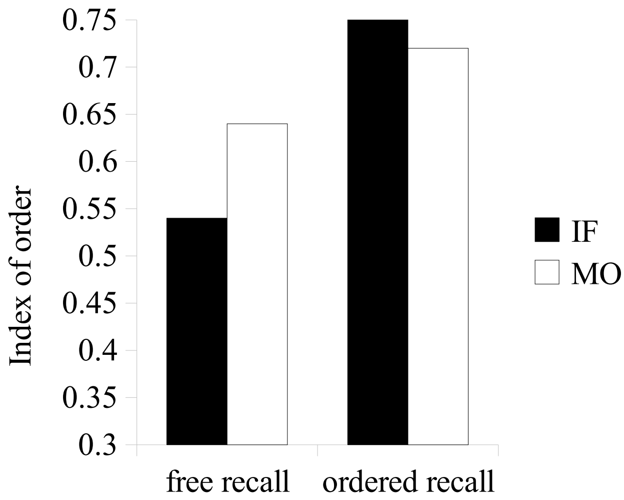


Figure 27: Index of order (0-1) as a function of the processing goal and recall mode.

5.5. Discussion

The results of experiment 5 show that item information was better retrieved when participants formed impressions, compared to when participants memorized the order of the information. This holds true for all impression formation conditions, whether involving comparisons or not. Order information was better retrieved and used when participants attempted to retrieve information in the original sequence. Furthermore, order information was better retrieved and used when participants formed impressions and attempted to recall information in order, compared to when participants free recalled the information after having formed an impression.

We expected that impression formation would facilitate the recall of item information as a consequence of the organized person memory structure that results from forming an impression. Results support this hypothesis. Participants instructed to form impressions, regardless of the specificity of the impression formation conditions, recalled more behaviors than participants instructed to memorize the order of the information. This is one more argument to the idea of impressions as memory structures that are formed associating elements among themselves in a network of interconnected nodes. Of further interest is the comparison between the “natural” and standard impression formation condition, and the condition that involved comparisons with different items. In fact, from the set of different impression formation conditions, one (compare with different) demanded for comparisons that could be at odds with the impression formation sense making processes. Results indeed show, replicating the findings of the other impression formation conditions, that participants instructed to form impressions comparing behaviors with different behaviors (different trait), recalled more items than the participants that memorize the order of the items.

For order information memory we expected, again having the associative chaining representational assumptions as a framework, that the pattern of results obtained in the previous experiment, in the regular contrast between impression formation and memorization of order processing goals, should occur only in the standard impression formation conditions (and not in the other impression formation comparison conditions). In the other impression formation conditions (the ones involving comparisons), the impression formation ability to retrieve and use order information should be hampered (excepting the impression formation condition that involved comparisons with the previous item), given the inter-item associations that were formed at encoding, competing with the inter-item order associations. Furthermore, according to the chaining hypothesis, the pattern of this inability to retrieve and use order information should be different across the impression formation conditions, since different conditions triggered different associative patterns. Results do not support this hypothesis. Participants that formed impressions, irrespectively of the specific impression formation conditions, were able to effectively retrieve and use order information when asked to do so, that is, in the ordered recall conditions. It seems that the extra associations did not disrupt the ability of impression formation to retrieve and use order information and, as such, these findings contribute one further evidence that forming impressions do not seem to represent order information along with what is postulated by the associative chaining theory. However, the manipulation that promoted different associations was not very successful given that the global performance was low in item memory. This conclusion must be tempered by the absence of differences in the impression formation conditions.

Summing up, in this fifth experiment we replicated the results of experiment 2, 3 and 4. In fact, order information representation, and subsequent use, does not seem to be based on the chaining process proposed by the chaining models of memory for serial order. We do not claim that order representation is independent of chaining but, instead, that order representation, access and use seems to go beyond the chaining assumptions.

6. Experiment 6

Now that two experiments (4 and 5), with two different manipulations, provided convergent evidence that increasing the amount of inter-item associations in the network (or network density) that represents the person in memory does not prevent the processes involved in impression formation to represent order information (which can indicate that the representation of order information in person memory is not associatively based), we intend to further test a representation of order that goes beyond inter-item successive associations. That is, attempting to test whether order information in person memory, instead of being represented in a chain of associations between items, can be represented in an indirect way. As such, this study was developed to start testing whether order information can be represented indirectly in person memory, in a non-associative and non-episodic, way.

To do so we decided to adapt a direct forgetting paradigm to the context of the present study. The direct forgetting paradigm was recently introduced in the study of person memory (Almeida, 2007), and it is a manipulation that is known to be extremely efficient in dissociating episodic from non-episodic memory, given that only episodic memory is sensitive to the direct forgetting instructions. Thus, with the sixth experiment we were trying to adapt a paradigm that affects episodic memory, and consequently, item information, to see what is the effect on memory for order information. If the episodic memory impairments that characterize the direct forgetting paradigm extend from item memory to order memory, than order information representation should rely on the same memory structure. If the direct forgetting manipulation does not interfere with memory for order, than it suggests that memory for order relies on a different memory structure.

6.1. Research question

With this experiment, the last from the set of experiments that are presented here, we intended to test whether item and order information are both based on episodic memory, or if the representation of order information is non-episodic, or episodic-independent in nature. Specifically, we were interested in knowing whether order information, different from item information, is represented in episodic memory, or if it is not and can be represented in an abstract fashion, independently of episodic memory, in the person memory structure. An episodic independent representation involves a higher order of abstractness, relatively independent from the specific information and the associations at the episodic level. To do so, it is necessary to test whether item and order information can be dissociated in terms of episodic and episodic-independent memory. The direct forgetting paradigm is able to dissociate episodic from non-episodic memory since it only impacts episodic memory, without interfering with non-episodic memory. The direct forgetting paradigm involves asking participants to either remember or forget part of the stimulus list. The remember conditions can be considered equivalent to the standard conditions used in the previous studies. In such cases, in the middle of the stimulus list participants are simply asked to keep remembering the information. Differently, the forgetting instructions involve informing participants that the information that was studied before should be disregarded and that only the part of the stimulus information presented after the forgetting instructions should be considered for the purpose of the study. Only episodic memory is thought to be sensitive to such manipulation. That is, only episodic information is impaired when people are instructed to forget a subset of the studied sequence of items. Non-episodic memory, on the other hand, since it is not dependable on specific information remains unaffected by such forgetting instructions. Therefore, in the present experiment we adapted the directed forgetting paradigm to person memory to know whether the retrieval of item information is impaired by the forgetting instructions (and so if item memory is based on episodic memory) and, more importantly, if order information is not (and so if order memory is not based on episodic memory). In fact, if order information remains unaffected by the forgetting instructions, then this is an important indicator that order information should involve some sort of episodic independent memory processing.

Summing up, the question guiding this experiment can be formulated as follows: are order and item information represented similarly as forms of episodic memory, or, as suggested by the findings from the previous experiments, are order and item information differently represented in person memory, based on episodic and episodic independent memory systems? If so, is the representation of order information episodic independent, and the representation of item information episodic in nature? If the literature establishes that item information is preserved in an associative network, through nodes that are connected by associative links (episodic memory), given that order does not seem to be represented in the same fashion by means of associative links, it becomes less obvious how order information is represented in person memory, specially taking into account the findings from the previous experiments. If it is not via the inter-item associative links, how is order information represented?

6.2. Hypotheses

In this last experiment we expected that (i) memory for the item information would be better under impression formation goal conditions than under memorization goal conditions. Additionally, we expected that (ii) participants instructed to remember the list would recall more items than participants instructed to forget it. However, this was expected (iii) to occur only in the impression formation conditions, where the processing of item information occurs in an attempt to make sense of the target that results in a detailed processing the specific features of each item. The processing involved in the sense making of impression formation should not only promote the recall of the content from the memory structure, but also, should be sensitive to the forgetting instructions prompt by the directed forgetting paradigm.

Regarding order information, if order information representation has an episodic independent component, (iv) then the pattern of results that was obtained in previous experiments was expected to occur in the present study as well. That is, the direct forgetting paradigm should not interfere with order information representation and use since order information would not be based on episodic memory. Therefore, the interaction between processing goals and recall mode should replicate the previous studies. This means that when people form impressions, the retrieval of information in free recall should not be based on order information, but in the ordered recall conditions, participants that formed impressions should perform as well in retrieving (or using) order information as the memorization of order participants. If this pattern of results is obtained in terms of memory for order with the directed forgetting paradigm, then the representation of order information in the person memory structure remained unaffected by the forgetting instructions, suggesting that the representation of order information in person memory is done in an episodic-free fashion.

6.3. Method

Participants

176 undergraduate students from the University of California, Davis (UC, Davis, USA), participated in the experiment in exchange for course credit.

Design

Participants were randomly assigned to the cells of a 2 (processing goals: impression formation set vs. memorization of order set) X 2 (directed forgetting: remember vs. forget) X

2 (recall mode: free recall vs. ordered recall) factorial design.

Material[28]

The material used in this study consisted in a subset of the behavioral descriptions pre-tested by Fuhrman and colleagues (1989). For this study, 24 behavioral descriptions were selected, describing four different personality dimensions (intelligent, friendly, adventurous, and extraversion) and one single target. As such, the target performs 6 behaviors from each of the four personality traits, in a total of 24 behaviors.

Procedure

Participants were initially informed[29] that they would take part in a study about impression formation (or in a study about the memorization of order). Afterwards, half of the stimulus list would be presented (12 behaviors) and, then, participants were instructed to either remember the (part of) list they have just studied, or to forget that list. In the forget instructions, participants were told that the behaviors that were presented initially were "practice sentences before the critical sentences that will now be presented". Differently, in the remember instructions participants were told that initially they have studied half of the list and that "now you will be presented with the remaining sentences". After studying the 24 behaviors of the stimulus list in a random order, each one presented automatically during 6 seconds in a computer screen, participants performed a distracter task. Lastly, they were either asked to free recall the behaviors that were presented at the study phase, or to recall the behaviors in the order they were presented in the stimulus list.

28 See *Appendix VI – Experiment 6: Stimulus Material* for the entire set of stimulus material from experiment 6.

29 For the entire set of instructions, see *Appendix VI – Experiment 6: Instructions*.

Dependent measures[30]

Item memory

Proportion of free recalled behaviors in relation to the total of behaviors presented in the stimulus list.

Order memory

Index that computes, between 0 and 1, how correct the recalled sequence resembled the original stimulus sequence.

6.4. Results[31]

Item Memory

The item memory proportions were entered in a 2 (processing goals: impression formation set vs. memorization of order set) X 2 (directed forgetting: remember vs. forget) X 2 (recall mode: free recall vs. ordered recall) factorial ANOVA.

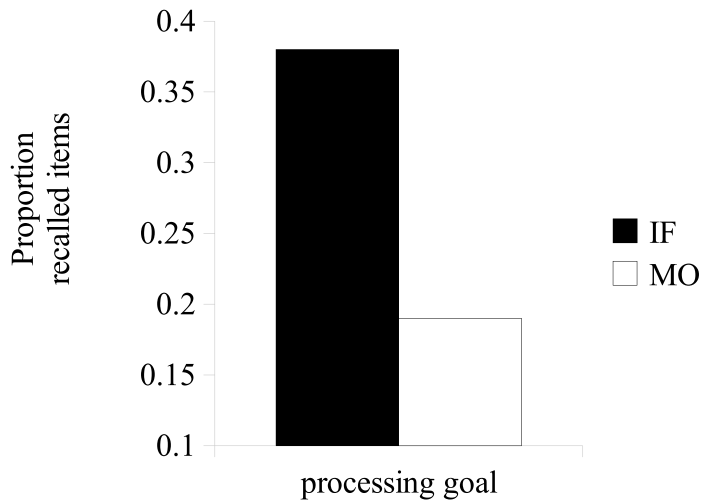


Figure 28: Proportion of recalled items as a function of the processing goal.

30 See *Appendix VI – Experiment 6: Dependent Variables* for the detailed computation of the dependent variables.
31 See *Appendix VI – Experiment 6: Test of Normality and Homogeneity of Variances* for the tests of normality and homogeneity of variances.

Results indicate, as predicted, and again replicating the previous experiments, a main effect (Figure 28, above) of the processing goals, F (1,168) = 92.86, p < 0.00, with the impression formation conditions recalling more behaviors (M = 0.38), than the memorization of order conditions (M = 0.19).

Furthermore, this main effect is qualified by an interaction (Figure 29, bellow) with the directed forgetting factor, F (1,168) = 5.25, p < 0.02. For the impression formation conditions, participants instructed to remember (M = 0.41) recalled more items than the participants instructed to forget (M = 0.34) (planned comparison, for IF, R vs. F: t (168) = 2.65, p < 0.01, one-tailed). For the memorization conditions there was no difference between the remember (M = 0.18) and forget (M = 0.20) conditions (planned comparison, for MO, R vs. F: t (168) < 1).

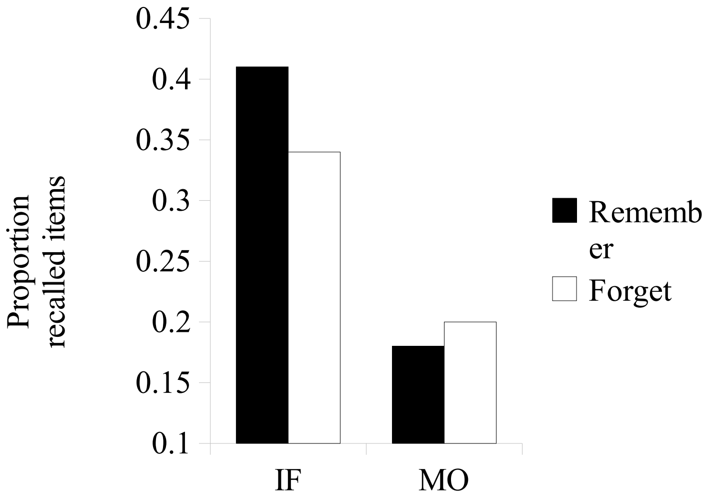


Figure 29: Proportion of recalled items as a function of the processing goal and directed forgetting.

Order Memory

The memory for order index was entered in a 2 (processing goals: impression formation set vs. memorization of order set) X 2 (directed forgetting: remember vs. forget) X

2 (recall mode: free recall vs. ordered recall) factorial ANOVA.

This analysis reveals a main effect (Figure 30, bellow) of the recall mode, F (1,168) = 3.79, $p < 0.05$, where the ordered recall conditions performed significantly better (M = 0.59) in using order information to retrieve information from memory, compared to the free recall conditions (M = 0.50).

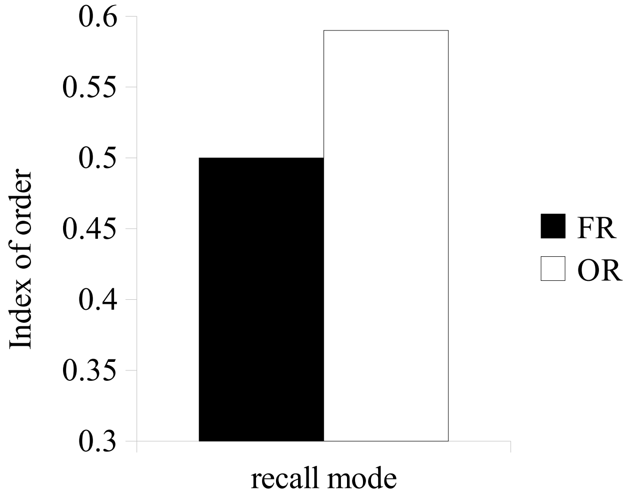


Figure 30: Index of order (0-1) as a function of the recall mode.

This main effect was qualified by a marginal interaction (Figure 31, bellow) with the processing goals, F (1,168) = 2.70, $p < 0.10$. Of interest is the replication of the previous pattern of results. In free recall, impression formation participants (M = 0.50) do not differ (planned comparison: t (168) < 1) from the memorization of order participants (M = 0.51), in using order information, whereas in ordered recall impression formation participants (M = 0.66) relied even more on order information (planned comparison: t (168) = 2.16, $p < 0.03$, one-tailed) than the memorization of order participants (M = 0.52). Moreover, and of greater importance, the planed contrast between the impression formation conditions in free recall and ordered recall, t (168) = 2.55, $p < 0.01$, one-tailed, indicates that impression formation participants performance in using order information to retrieve information from memory increased from the free recall (M = 0.50) to the ordered recall (M = 0.66) conditions. These effects were not moderated by any of the remaining variables, namely by the directed forgetting factor.

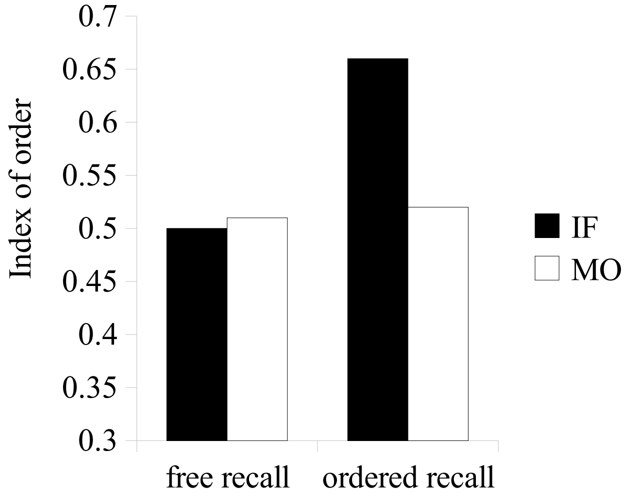


Figure 31: Index of order (0-1) as a function of the processing goal and recall mode.

6.5. Discussion

Results of experiment 6 show that item information was better retrieved under impression formation goal conditions, replicating previous experiments. Of further importance, item information was affected by the directed forgetting manipulation, with forgetting instructions resulting in less information recalled, compared to the remember instructions, suggesting that indeed item information representation in memory relies on episodic memory. Results regarding order information replicated the pattern of results obtained in previous experiments, with impression formation being able to retrieve and use order information when participants were instructed to do so in the ordered recall conditions. Of further interest is the fact that such pattern of results remained unaffected despite the direct forgetting manipulation, that is, impression formation ability to retrieve and use order information was not impacted by the forgetting instructions, suggesting that order information representation in person memory is indeed (at least partially) processed in an episodic independent memory fashion.

We expected that impression formation would facilitate the recall of item information. Results support this hypothesis. Participants that were instructed to form impressions were able to recall more behaviors than the participants that memorize the order of the items. Again, replicating previous experiments. Of higher relevance is the fact that we expected that if item information would rely on episodic memory, then memory for item information should be affected by the directed forgetting instructions, that is, when instructed to forget the information people should be able to recall less information from memory. This should be the case especially for the impression formation conditions. Results support this hypothesis. In fact, participants instructed to form impressions recalled fewer behaviors when asked to forget a subset of the stimulus list, compared to when they were told to remember. As such, item information was sensitive to the manipulation that is known to impact episodic memory.

We expected that if order information would be represented in person memory in an episodic independent fashion, then the ability to retrieve and use order information should not be impacted by the directed forgetting manipulation, since such manipulation is known to dissociate episodic and non-episodic memory, by affecting episodic memory while episodic independent memory remains untainted. Therefore, we expected that impression would facilitate the retrieval and use of order information, but only in the ordered recall conditions. Results support this hypothesis. Participants instructed to form impressions did significantly better in using order information to retrieve information from memory in the ordered recall conditions, compared to the free recall conditions. Since this pattern replicates previous experiments, without any interaction with the directed forgetting manipulation, it seems that order information is not sensitive to the manipulation that is known to impact episodic memory, suggesting that the representation of order information is based on episodic independent memory.

Summing up, with this study, a paradigm that has been used to dissociate episodic and non-episodic memory was used to test whether item and order information could be based on these different memory systems. The results obtained with this experiment are fascinating since they show that item information memory performance was in line with the findings typically obtained for episodic memory, but for order information memory, performance seems to be in line with the findings usually obtained for episodic independent memory.

GENERAL DISCUSSION AND CONCLUSIONS

1. Summary of the main findings

Six experiments were conducted to address the problem of order information representation and retrieval in person memory. We adapted the typical impression formation paradigm, originally developed by Hamilton and colleagues (1980) to study episodic item information, to the study of memory for order. Such adaptation involved, on the one hand, the inclusion of measures of order information along with the traditional measures of item information and, on the other hand, the direct manipulation of the organization of the material describing the target(s) person(s) in the stimulus list.

Overall, in terms of item information, the data from the set of six experiments is perfectly in line with our hypotheses, replicating and extending well-known and established findings in the impression formation literature. That is, the contrast between an impression formation processing goal and a memorization processing goal results in item memory advantage for people that formed impressions, compared to the ones who memorized the information. This item memory advantage was obtained with free recall measures and measures of source memory. So, forming impressions leads to more items recalled, as well as to better identification of the source (target) of the items.

Regarding memory for order information, the set of results from these six experiments is far more complex than the results obtained for item memory. Such intricate findings are the consequence of several different reasons. First, it was necessary to tune up an appropriate measure of order information for the context of a typical impression formation paradigm. Second, it was necessary to tune up the experimental setting, namely the stimulus material, from lists describing different targets, to lists describing a single target, and lists portraying a single or multiple personality traits. Third, and most importantly, alternative explanations had to be discarded.

1.1. Experiment 1

Data from experiment 1 shows that memory for order information was not different across processing goals, contrary to our hypothesis, which predicted that the memorization goal would outperform the impression formation goal. Additionally, order was better retrieved when information was in successive positions, compared to non-successive positions. Also, participants more easily retrieved order information when the information they had to order described the same target, compared to the situations in which the information described different targets. Of further interest, when information described the same target, the impression formation processing goal facilitated the retrieval of order information, in comparison to the memorization goal. Thus, regarding memory for order, essentially results did not follow our predictions and, if something, when information portrayed the same target, results followed the opposite direction, that is, impression formation outperformed the memorization goal. Apart from a measure of order information that might have been inadequate for testing the chaining hypothesis under scrutiny, the multi-target setting used in this first experiment constitutes a potential major caveat, given that simpler processing may have resulted in information organized by target, simply promoting intra-target temporal chaining. Such a process may have lead to the results obtained in experiment 1. Thus, instead of the impression goal promoting the development of inter-item associations at encoding that were independent of order, the multi-target material may have artificially inflated temporal chaining. The non-temporal chaining that we were expecting that would disrupt order information representation and retrieval may have been replaced by temporal chaining, even for people under the impression formation goal.

1.2. Experiment 2

For experiment 2, and given that a potential problem of experiment 1 was the multiple target experimental setting, the stimulus list was changed to reflect behaviors performed by a single target. Furthermore, two different measures of order information were used in an attempt to better access memory for order. Results from Experiment 2 indicate that one of the measures of memory for order was not discriminative, given that no differences were recorded across the only factor under analysis, the processing goals. Still, the second measure of order memory, a direct measure of chaining, contradict our prediction, revealing that participants that formed impressions relied more on order information to recall information from memory, that is, used more chaining, then participants that have studied the information with a memorization processing goal. So, in terms of order memory results are at odds with our prediction. Again, in the context of the experimental setting of the second study, where apart from describing the same target, all behaviors are illustrative of the very same personality trait, even when people form impressions the material can be promoting temporal associations instead of alternative and order-independent associations between items. In such a setting, the predicted associations that would be developed between each newly perceived item and the items previously encoded items are unnecessary to better understand the target. Thus, the relational processing that characterizes impression formation is directed to process and associate items that more likely co-exist in working memory, which are the items in successive positions in the stimulus list. Therefore, such findings may result from the fact that instead of the impression formation goal promoting the development of associations between items that are independent of order, to reach an organized person memory structure that maximizes the sense making purpose of such processing goal, impression formation might be artificially promoting temporal chaining. So, instead of impression formation goal resulting in a network of inter-item associations independent of order (non-temporal chaining), impression formation results in temporal chaining. If in the first experiment the problem was that the material was too complex (describing multiple targets), in the second experiment the material was too simple (describing a single target and a single trait). Since all information was homogeneous in terms of trait information, no organization is necessary to understand the target and, thus, impression formation may naturally result in temporal chaining.

1.3. Experiment 3

With experiment 3 we tried, once more, to develop an experimental setting where the impression formation organizational processes would be at odds with the representation of order by the associations of items in temporal contiguous positions. We adapted the previous stimulus list to describe not only a single target but also multiple traits. In this case, impression formation sense making processes should result in a trait cluster based organization, which should be independent of temporal chaining that results from associating items in successive positions and thus solving the potential caveats that derived from the material of the two previous experiments. Data from experiment 3 finally provided the double dissociation hypothesized for experiment 1, 2 and 3, that is, if impression formation would boost memory for item, it would hinder memory for order, in comparison with the memorization goal. However, of further interest, data also show that such dissociative pattern is illusory. The memorization processing goal outperformed impression formation conditions in using order information only when participants freely recalled information from memory. In fact, when participants were directly instructed to remember item information tapping into order information, participants that formed impressions were as good in using order information as the ones that memorized the information. Therefore, although impression formation participants do not rely on order information to freely recall information from memory, order information seems to be accessible when there is the need to retrieve it. Therefore, impressions seem to generate memory structures that are able to represent order information, and later access it.

1.4. Experiment 4

With a multiple trait experimental setting, impression formation seems to result in a trait-based representation, where the amount of inter-item associations is limited given that associations tend to be promoted between the trait clusters. So, for experiment 4 we developed a more dynamic setting that would directly promote the development of inter-item order independent associations. As such, in experiment 4 we introduced a manipulation of expectancies and incongruent information, expecting that such information would boost the development of inter-item associations at encoding, while increasing the difficulty of the task. Increasing the amount of inter-item associations (chaining) should interfere with order. Results of experiment 4 indicate, on the one hand for item memory, congruent and incongruent information is better recalled, compared to the irrelevant information. People that formed impressions have better memory for item information, but exclusively for congruent and incongruent information. On the other hand, in terms of order memory, the pattern of results perfectly replicates the findings obtained in experiment 3, despite the presence of incongruent information and its likely consequent increase in the inter-item associative density. The difference in the use of order information across processing goals disappears when participants are explicitly instructed to use order information. That is, although people do not seem to rely on order information to spontaneously retrieve information from memory, when such information is directly requested, people that formed impressions are able to access and use order information, which is an important indicator that order is represented and retrieved from the memory structure that is created when people form impressions. In experiment 4, although it is likely that, compared to the previous experiments, a network with a higher density of inter-item associations was developed, results replicated the previous experiment, which seems to suggest that independently of the inter-item associations that are formed at encoding, impressions represent and use order information. Furthermore, it suggests that order representation is, at least to a certain level, independent of a chaining mechanism.

1.5. Experiment 5

Although experiment 4 suggests that order information representation and use does not seem to rely on chaining, the incongruency effect obtained in experiment 4 did not reach statistical significance, despite the good memory for incongruent information, which should lead us to interpret the data from the last study cautiously. Thus, experiment 5 constitutes an attempt to directly and explicitly manipulate the associations that are made at encoding, to test whether promoting inter-item associations that are independent of order result in poorer memory for order. The data from experiment 5 suggests that, in terms of order memory, despite the manipulation that was intended to result in distinct associative networks that would differ in the amount and type of specific inter-item associations, the pattern of results replicated experiment 3 and 4. That is, when people that were forming impressions retrieved information from memory without any constraint, order information is not spontaneously used. But when participants that formed impressions retrieve information from memory with the instruction to use order information, they are able to do so. Therefore, despite the manipulation that promoted specific types of associations at encoding, the ability to use order information was not affected by such alternative associations, further suggesting that order information representation in person memory is independent from chaining. The absence of differences between the impression formation conditions in item memory suggested that the manipulation of the comparisons that were done at encoding, and that were likely to result in associations in memory, was not very strong. Therefore, a stronger paradigm, known to interfere with episodic item memory, is necessary.

1.6. Experiment 6

Finally, experiment 6 intended to adapt and introduce a paradigm that is known to dissociate episodic form episodic-independent memory, to the study of order information in person memory. This manipulation directly interferes with the ability to elaborate on episodic information, hindering the ability to develop inter-item associations (chaining). If order information representation is independent of the chaining mechanism, that is, independent of the inter-item associations that are developed at encoding, as it was strongly suggested by the previous two experiments, then order information representation should be independent of episodic memory and, thus, should not be affected by the direct forgetting instructions. The direct forgetting paradigm was introduced to assert whether item information was effectively tapping into episodic memory and, more importantly, if order information was not. Results support this hypothesis, showing that although the manipulation of direct forgetting was effective, it only affected item memory, not order memory (particularly the impression formation conditions), that is, people instructed to forget end up remembering less information than people instructed to remember. These findings seem to suggest, with a manipulation that is less susceptible to alternative interpretations, that order information representation is based on episodic-independent information and, thus, may be represented independently of the inter-item associations that are developed to represent information in memory.

1.7. Summary

We started the quest for order information representation and use in person memory with the hypothesis that, if people would be able to represent and use order information about persons in memory, then the representation of such information should follow the tenets of the associationist ideas, via a chaining mechanism. This would mean representing and retrieving order information by means of the associations that are developed between items. Such associations would represent temporal order, so that items in successive positions would be directly associated. This conceptualization predicted that the organizational processes involved in forming an impression about a target, which involved building a coherent representation of the target, where items are clustered by trait, and information is represented to maximize the sense making purpose of impression formation, would interfere with the development of inter-item temporal associations between items in contiguous positions in the stimulus list. Thus, the traditional contrast between an impression formation processing goal and the memorization processing goal should result in better memory for order for the memorization goal, given that no sense making activity promotes an organization independent of temporal order. Also, the event memory proposal by Wyer and colleagues (1985) was also extremely pessimistic regarding order information representation (and use) in the domain of person memory research, particularly for the impression formation paradigm. According to this model, order representation would not take place in such temporal (or ordinal) meaningless settings. Additionally, the model posits that order could only be coded for macroscopical units, which do not exist in the experimental contexts used in the present research program. Therefore, both the event memory proposal, and the chaining hypothesis were extremely pessimistic as to the ability of order information representation when people form person impressions. However, the gist of the data just described is, on the one hand, that order information representation takes place when people form impressions, directly contradicting the event memory temporal coding proposal, as well as the chaining assumption that would predict that order information representation would be hindered when people formed impressions. On the other hand, order information representation in the domain of person memory seems to take place independently of the chaining mechanism, or the inter-item associations that are built at encoding and that characterize the memory structure describing the target.

2. Contributions

2.1. Revisiting the existing theories and the current data

i) The event memory proposal

According to the model proposed by Wyer and collaborators (1985) order information should not be preserved in contexts where, first, information could not be organized in units that aggregated several events and, second, where the general knowledge people have about the world cannot determine the temporal location of information. First, Wyer and colleagues (1985) propose that temporal coding takes place at the unit level, that is, at a higher level that aggregates information together. For example, the events that constitute having dinner at a restaurant, like ordering, eating, etc., are grouped together in the macroscopical event unit "eating at a restaurant", and the events that are part of going out for drinks, like finding a bar, having a beer, etc., are within a different unit, "going out". These two units receive a temporal code and, thus, we can either go out for dinner and then for drinks, or the other way around. That is, the event memory proposal for temporal coding is able to differentiate between the two situations. Second, the model asserts that no temporal coding will take place within the units, that is, between discrete events, since people use the general knowledge they have about the world to make order judgments. For example, people can rely on the previous knowledge they have to know that eating at a restaurant involves ordering in the first place and, only after, enjoying the meal. In the same vein, usually people first find a bar, and only after start drinking beer.

In the context of the present research, and most of the person memory literature, information cannot be organized in units with any kind of temporal, causal, or other meaningful relation and, furthermore, at the item level people cannot rely on the general knowledge they might have about the world to assert which item came first, second, and so forth, and so on, given that information was presented in random sequences, and no causal or temporal relation exist between the items.

Data from the set of six experiments strongly indicates that order information is represented and used in the context of person memory research and the impression formation paradigm, which directly contradicts the predictions of the event memory proposal given that information could not be aggregated in meaningful units, and no general knowledge could be used to represent, retrieve or reconstruct order at the item level.

ii) The chaining proposal

According to the chaining models reviewed earlier (Crowder, 1968; Ebbinghaus, 1885/1964; Murdock, 1982, 1983, 1993), order information is represented by the development of associations between items in successive positions in the world. Thus, order information is represented in the associations between items in contiguous positions in the stimulus list, in a chain that reflects the temporal order in which information was perceived and encoded into memory. Order information can be retrieved following the direct inter-item associations, where each item is used as a cue to reach the next item in the chain of temporal items, thus, each item triggers the association to the following item and order is accessed by the string of items that is produced when people retrieve information from memory. In a person memory experiment associations would be developed between behaviors in contiguous positions in the list to represent order information. For example, as illustrated before, the fifth item would be associated to the fourth and to the sixth item, the sixth would also be associated to the seventh, the seventh to the eighth, until the end of the list. Hence, such process result in as many inter-item successive associations as the amount of items in the list, minus one.

For the person memory associative network structure, apart from the already assumed inter-item associations (more likely to occur when incongruent information is present in the studied material), there would be inter-item associations between the items that have been studied consecutively. Therefore, the representation of order information would take place in a chain of successive items. This temporal or ordinal chaining process is in line with the person memory model. In fact, the person memory model would remain as it is regarding the representation of item information. Differently, the representation of order information would take place associating items in contiguous positions.

Such person memory conceptualization built on the chaining models is derived from the same associationist principles that characterize the person memory model and the way information is represented and accessed in memory. In person memory, information is represented by the establishment of associations between items and other elements of the memory structure that represent the target person, and those associations are used to retrieve information from memory. The resultant memory structure is an organized representation in memory. Such person memory structure is hierarchical, with different nodes at distinct layers. The target, central node, is situated a the top of the hierarchical memory structure. Bellow, there are the trait nodes. At the bottom level of such hierarchy there are the behavioral nodes. This hierarchically organized memory structure is originated by the organizational processes involved in forming an impression. The associative principles of the person memory structure result in the development of linkages between the bottom-level nodes (i.e., behavioral nodes) portraying the same target. The trait nodes are, themselves, associated to the target node. Forming an impression means that information that is perceived in the world is (re)organized in a memory structure describing the target person (Wyer, Budesheim, Lambert, & Martin, 1989). The organization that is build in memory has the purpose of making sense about a target, therefore, the organization of information ends up being distinct from the sequence in which the information was perceived. Hence, items in successive positions should be less likely to be associated among themselves in the memory structure representing the target. As described in page 153: "(...) *if the item in the fifth position of the stimulus list is an intelligent behavior, and the item in the sixth position is an altruistic behavior, and if, furthermore, the item in the seventh position is another intelligent behavior, it is highly likely that according to the organizational processes involved in impression formation, the two intelligent items will be represented together in a trait-based representation. Simultaneously, it is highly likely that the altruistic behavior will be represented together with other altruistic behaviors. (...) As such, the probability of an intelligent item and an altruistic item to be bound in memory is low, even if these items appeared in successive positions in the stimulus list.*"

Therefore, the organizational processes that are known to characterize impression formation are tuned to maximize the development of a coherent and integrated representation of the person, which involves organizing and arranging information in the memory structure in a way that tends to be independent from the simple and straightforward sequence in which information was perceived. If information describes multiple personality traits, the impression formation organizational processes will group information that represent the same target together in the memory structure, in an attempt to organize information in a way that promotes a memory structure representing the person that is meaningful, efficient and coherent. It is thus expected that impression formation sense making activities will lead to the development of associations between items in a chaining mechanism that is independent of order information. Forming impressions, according to such conceptualization, involves interfering with the development of inter-item successive associations that characterize temporal or ordinal chaining. The contrast of an impression formation goal with a memorization goal, that is less likely to trigger such organizational processes, was expected to result in worst memory for order for the impression conditions, in comparison to the memorization conditions.

Results from the set of six experiments, some of them specifically designed to interfere with the associative density of the network structure that would result from forming an impression, seem to indicate that, on the one hand, impressions are as good in representing and accessing order information as the representations that resulted from a specific processing goal of memorization of order. On the other hand, despite different manipulations that directly interfere with the inter-item associative structure of the person memory representation, the ability of impression formation to represent and access order information was not hindered, suggesting that order representation and retrieval is independent of the associative chaining mechanism.

2.2. Alternative proposal: Directions for an ordinal model of order information in person memory

With the idea that order information is represented at the item level (contradicting the event memory proposal of temporal coding for order judgments), that impressions are effective in representing and retrieving order information, and that order seems to be represented independently of a chaining mechanism, together with the findings from the last study suggesting that order information representation is episodic-independent, we want to open the discussion to a theoretical possibility to account for order information representation in person memory that is independent of the chaining assumptions, and therefore the chaining models, and that is theoretically closer to the ordinal models of memory for serial order (Brown, et al., 2000; Estes, 1972; Page & Norris, 1998; Shiffrin & Cook, 1978).

We started this work thinking that order information representation in person memory would follow the tenets of the chaining model of memory for serial order. Chaining models assume, indeed, that information is represented in memory by the establishment of associations, or links, between items. Order information, specifically, is represented by associations between adjacent, or successive items. In a similar vein, the person memory model assumes that information is represented in a network of inter-related items, with the inter-item associations playing a crucial role in person representations. Even further, the chaining model of memory for serial order and the person memory model share the same retrieval assumptions and formulate the same retrieval processes. Information is retrieved traversing the links between items in the representation. The amount and type of associations are different between the chaining and the person memory models, however, the same operating processes are expected to be running to retrieve information from these associative structures. Although from the theoretical standpoint an associative chaining model for the representation of order information in person memory seemed reasonable and plausible, data from different studies led us to conclude that the representation of order information in person memory is (at least partially) independent of the inter-item associations that are built in the person memory associative network structure. Beyond the seemingly perfect fit at the encoding, representational, and retrieval level between the chaining ideas from the memory for serial order literature and the person memory model, the representation of order information in person impressions revealed itself less intuitively represented in the memory structure people build to represent persons. The theoretical models in which we kept sipping for theoretical inspiration were the ordinal models from memory for serial order. The ordinal ideas are also able to account for long-term memory representations. Furthermore, we brought the contribution of another literature (episodic and non-episodic, or semantic, memory distinction,) for the discussion of this theoretical proposal of memory for order in person impressions.

Both chaining and ordinal models are able to inform our understanding of order in person memory since both assume long-term memory representations to explain the memory for serial order phenomena for non-social information. However, although both types of models are rooted in long-term memory representations, they constitute dramatically different ways to understand the representation of order in memory. Chaining models assume specific associations between the successive items in a sequence, whereas ordinal models assume that order is indirectly represented by an ordinal dimension. If chaining models seem to correspond to implementations of episodic memory models, ordinal models seem to correspond to more abstract representations, with features of episodic-independent memory.

i) *Ordinal proposal: Coding for an ordinal dimension in person memory*

The ordinal proposal asserts, quite simply, that the representation of order information in person memory would occur by coding the value of each item in a given ordinal dimension. Order information would be retrieved by accessing each item and tapping into the ordinal value attached to, or contained in it. However, order information would not be retrieved in absolute terms but rather in relative terms. That is, any given value of the ordinal dimension would be meaningless by itself. Order information could only gain meaning comparing values of different items in the ordinal dimension. Admittedly, people access a behavioral node and represented in (or with) such node there is an ordinal value, which confronted with other item's ordinal values can inform about the relative order of the item in the sequence of items.

The question is, then, which dimension is used to represent order information. Ordinal models of memory for serial order have put forward different possibilities. One, plausible possibility in the impression formation setting, is that the activation of the start of a list of behaviors (or the beginning of an array of information in the outer world) functions as continuous dimension in relation to which information is represented. Order is determined by the value of each item in that dimension. At the beginning of the list, the start marker has its maximum activation strength, loosing its intensity as the sequence proceeds to the end. Thus, the strength of activation of the start marker could work as the dimension that codes the order information of each item. As such, order would be indirectly represented in the person memory structure, independently of the associations between items.

In the person memory typical experimental setting this would mean that whenever each item is perceived, it would receive a value coding the item in relation to the activation of the start marker. As such, the fifth item would, in principle, receive a higher value in the ordinal dimension than the sixth item, which in turn would have a higher value than the seventh, and so forth and so on.

If the associative chaining proposal requires the existence of further associations to represent order information, the ordinal proposal does not require any other representational elements in person memory, neither extra informational nodes, nor associations. The only required add-on would be at the behavioral node level. Behavioral nodes would have to code for the ordinal dimension, besides their current job representing item information. If this would be the case, the person memory model, as it is with the same representational elements and set of processes, could cope with the representation of order information. This theoretical possibility for the representation of order information in person memory should be relatively independent of the nature and amount of associations that exist in the network structure, given that order in represented indirectly and, as such, whenever an item is retrieved, its ordinal value is accessed. According to this proposal, information would be retrieved following the inter-item linkages, where each retrieved item cues the next item to be retrieved, as the typical retrieval process is assumed to take place in the person memory. As such, people do not retrieve information following associations in a chain, but rather information is retrieved using the existing inter-item associations. Whenever an item is retrieved, its order value can be accessed and, if necessary, used to place the item in a sequence, or inform about the relative position of the item in terms of the stimulus list.

i.i. Episodic and episodic-independent memory in order information in person memory

Episodic memory refers, essentially, to the representation of specific events, which bridges item information into episodic memory. Order information seems, differently, episodic independent and, thus, it could be speculated that it is processed with features of semantic memory.

Item information in person memory has all the features of an episodic memory representation since it involves remembering specific information from one's past, like the vivid details of how fast did the person won the chess tournament, or the place where it took place. Order information, differently, seems to be represented at a higher level of abstractness and, more importantly, seems to be represented in a relatively independent way from the episodic details of the item information. To claim that order information representation takes place in an episodic-independent memory fashion entails that order information representation in the ordinal dimension has relational features. This possibility for an alternative to the chaining representation of order in person memory assumes that people represent and retrieve order in an indirect way. Order is processed not in absolute terms, but rather in relative, indirect and abstract ordinal terms.

i.ii. Summing up

Such theoretical ordinal proposal – which represents order information in person memory by means of an ordinal dimension that has characteristics of episodic-independent memory – seems to fit with the current experimental data. In the chaining proposal order is represented by associations between successive items, which can be contradictory with the organizational processes of impression formation if successive items portray different targets and/or different traits. Quite differently, according to the ordinal proposal, memory for order should not be impaired by such multi-trait and or multi-target experimental settings, and the consequent organizational processes that are triggered, given that irrespectively of the nature of the representation, its organization and the associations that exist between the items in the network structure, order information is simply accessed by retrieving a behavioral node and reporting its ordinal code. As such, whether the item in the fifth position is intelligent, is performed by John, and is represented together with the other intelligent behaviors performed by John, the ability to retrieve order information remains unaffected, regardless of whether the sixth item is altruistic and performed by Peter, or intelligent and performed by John.

In the chaining proposal, order information is used to further retrieve information, that is, order information cues, by means of the inter-item successive associations, the next item to be retrieved, in a chaining process. Differently, in the ordinal proposal order information has no role in determining the sequence of retrieved information. That is, according to the ordinal proposal the retrieval of order information is a byproduct of retrieving item information, playing no role in shaping the retrieval of subsequent information.

ii) Modeling order information in person memory: An indirect route

From the earlier chaining account, to the later ordinal proposal, our theoretical ideas over the representation of order information in person memory have evolved as our experimental work unfolded.

The current proposal entails an indirect representation of order by means of an ordinal model. An important feature of such a proposal is that order information is represented independently of the associations that exist at the memory structure, that is, order representation does not take place by a chaining process. This chaining independent mechanism to represent and retrieve order information is what we named the indirect route for order information in person memory.

Recapitulating, what the ordinal proposal for order memory in person impressions entails is, essentially, a differentiation of item and order information in terms of the type of memory in which each is based, and the type of processing each triggers. On the one hand there is item information, prone to be represented in an episodic memory fashion. On the other hand there is order information, prone to a representation in the fashion of semantic memory. Order information is not encoded *per se*, like item information in the chaining mechanism. Instead, a feature that correlates with order is used as a proxy of order information. For example, order information can be correlated with items' strength, which is affected by proactive inhibition – the more an item is further away from the beginning of the list, the stronger the interference of inhibition caused by the other items already encoded.

iii) Summary

We intended to lay out some theoretical ideas that can be helpful to understand order information representation in person memory. The models that have been discussed are theoretical possibilities that integrate the person memory model with different representational assumptions from the memory for serial order literature, as well as the episodic and episodic-independent memory distinction. From the initial chaining ideas we moved to the ordinal ones, where order information is represented in an indirect fashion, by coding for the value of items in a relatively abstract ordinal dimension, with characteristics of episodic-independent memory.

When people form impressions the chaining that is built at encoding to represent information in an organized memory structure is not used when people freely recall information from memory. Although associations are built at encoding, they are not spontaneously used at retrieval. However, order information is preserved and accessed when there is the need to it, therefore, people do not seem to retrieve order using temporal chaining. If the chaining models do not cope with such array of findings, the search for theoretical alternatives lead us to the ordinal models, given that for randomized, long and arbitrary sequences, the event memory proposal was also unable to explain the set of findings obtained in the six reported experiments. An ordinal model posits that a given dimension, or variable is represented and indirectly associated to order.

3. Empirical limitations and future directions

3.1. Serial position and informativeness: A plausible ordinal dimension

One possibility for an ordinal dimension to code for order information representation in person memory is the items' perceived informativeness. Informativeness seems to be correlated with the position of the items in a sequence, with the items closer to the beginning of the list being perceived as more informative and, in consequence, weighting more heavily on final judgment, compare to the items close to the end of the list (Anderson, 1973; Asch, 1946). Thus the closer an item is to the beginning of a list; the more informative it should be perceived to be. For example, when people perceive a set of intelligent behaviors describing a target, the first items are perceived as more informative for the development of the personality impression, than the latter intelligent items, given that the latter items not only are congruent with the previous ones, but also confirm the initial impression. The same can be true for list with diversified information, that is, even if the list is constituted by items illustrating different traits, the first item from each trait category will be considered more informative than the remaining items from the same trait. We suggest that participants could reverse the relationship from serial position to informativeness, such that participants would infer that the more informative items would have appeared earlier in the list. Thus we propose that perceived informativeness could be used as a proxy for order information, serving as an ordinal dimension in which although order information is only indirectly stored, it provides a cue for judgments of primacy, recency or serial order. In the final section, we present a few ideas for future studies targeted at testing this possibility.

3.2. Future studies

An exhaustive person memory model has to account for the representation of item and order information. A revised and updated theoretical integrative person memory model should account for item information in episodic terms, and order information in an abstract semantic fashion. The following experiments constitute an attempt to better test an integrative person memory model able to account for item and order information representation and retrieval. Three studies will be presented relying on the interplay between behavioral and neuroimaging studies.

i) Pilot study

Pilot study is a pretest to develop behavioral descriptions that vary in terms of diagnosticity. The goal is to create two trait-lists (intelligence, friendliness), each with 20 highly, 20 averagely and 20 poorly informative behaviors. First, a group of participants generates sentences illustrative of each personality trait. Second, a different group is presented with 100 behaviors portraying each trait and, using rating scales, ranks each item in terms of informativeness and the trait implied. To compile the two trait-lists the top, middle, and bottom 20 items in terms of trait/informativeness ratings, will be selected as the highly, averagely, and poorly informative items.

ii) *Experiment 1*

The first experiment is a behavioral study designed to better assert the episodic free component of person memory. We aim to test a person memory model that goes beyond episodic information, showing that impressions rely on indirect information to represent and retrieve order from person memory. It is assumed that such processing has characteristics of semantic processing.

We hypothesize that order information is represented as a byproduct of items' perceived informativeness. Items at the beginning of a sequence are perceived as more informative to the emerging impression. Informativeness decreases as the item's position is further away from the list-start. Order information is inferred from the item's informativeness, i.e., the more an item is informative, the more it is perceived as being closer to the list-start. Thus, we hypothesize that people retrieve order information by accessing the item informational value, relating it to the abstract informational dimension and inferring its position in the sequence.

First, we expect that for items pretested as having the same informativeness value, items presented at the beginning of a sequence will be evaluated as more informative, than items presented at the end. Second, manipulating items' informativeness, and their position in the stimulus list, should lead participants to consider, at recall, that highly informative items appeared first in the list, even when they were presented in middle or final positions.

Participants are randomly assigned to a 2 (processing goals: impression formation – IF vs. memorization of order – MO) X 3 (item's informativeness: high, average, low) X 3 (informativeness position: beginning, middle, end) factorial design, the second factor being manipulated within-subjects. Participants study the stimulus material, then perform a distractor task to clear working memory, and finally serially recall the studied information. Item (number of items recalled) and order (correctness of the recalled sequence) information will be measured. Lastly, participants rank each item in terms of informativeness.

iii) *Experiment 2*

Experiment 2 is similar to experiment 1, but uses an adapted order recognition measure. The material is constituted by averagely informative behaviors. At retrieval, participants make order judgments relative to the behaviors studied before. Pairs of items are presented and participants have to select which item appeared first. In half of the trials items have been presented before, whereas in the other half, one of the items in the pair is new, and could be either high or low on informativeness. Our hypothesis is that new highly informative items will be more frequently selected as the first item, compared to the new poorly informative items. Participants are randomly assigned to a 2 level (processing goal: IF vs. MO) design. They study the stimulus list and, after the distractor task, serially recall the items, before the order recognition measure.

iv) *Experiment 3*

Experiment 3 is a behavioral and fMRI study inspired by Mitchell, Macrae and Banaji (2004), designed to test the neural correlates of item and order information processing in person memory. Bearing on the assumption of item/episodic and order/semantic information representation, we expect that item retrieval is associated with right frontal regions (episodic retrieval) and order retrieval is associated with left frontal regions (semantic retrieval). Participants are randomly assigned to a 2 (processing goal: IF vs. MO) X 2 (recall mode: item recognition vs. item ordering) within-subjects design, and are scanned while they learn and remember the stimuli.

Participants perform two retrieval tasks intermixed in a random order (interval: 500-7500 msec). In the item recognition task participants are presented with pairs of old and new items. Participants have to select the item presented at the study phase. In the *item ordering task* participants are presented with pairs of previously presented items. Participants have to select the item that was presented first at the study phase. If item recognition is assumed to rely on item information, item ordering is assumed to depend on the retrieval of order information.

With these studies we intend to better test an integrative person memory model that is able to integrate item and order information representation and retrieval in person memory.

The work that was reported in this thesis intended to start the systematic study of memory for order information in the domain of person memory. Although person memory is an extraordinary developed research arena, it has been dealing only with the processing, representation and retrieval of items in memory. Up to this moment, order information was absent from person memory research. As Asch (1946) noted in the early foundation of social psychological research on impression formation, "*the importance of the order of impressions of a person in daily experience is a matter of general observation*". Order seems a fundamental element of utmost importance for structured and meaningful memory representations of the world in general, and representations about persons in particular. In line with this general prediction, we know now that order information is indeed represented, retrieved and used when people form impressions about targets. At the very least, when people form impressions they are able later to use order information in recall or order reconstruction judgments.

The person memory model, as it is, is unable to account for the representation and retrieval of order information. The associative principles of the person memory model, namely the chaining that is built at encoding, and used at retrieval, seems to be independent of order representation and use. Thus, the memory model that seemingly best fits the data that have been presented and discussed in the present thesis is an ordinal model for the representation and retrieval of order information in person memory. Such model seems to be compatible, or implementable, within the person memory model framework.

It seems that for the impression that you have developed about the new colleague that just moved to your department, and that was introduced to you at lunch time (i.e., at the very beginning of this thesis), it was indeed extremely important that he first helped the lady that fell on the grass, and only after kicked the sleepy squirrel. If otherwise, well, one can get a pneumonia with an icy shirt. And no one really wants to have a pneumonia, specially now that H1N1 is out there.

We hoped we have taken the reader from stories about running geeks, witches with flying brooms that read Popper, the literatures that directly and indirectly relate to the study of order in person memory, to the research and theoretical ideas that were developed and put forward to cope with the representation and retrieval of order (and item) information in person memory.

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APPENDICES

Appendix I – **Experiment 1**

1. Stimulus Material

1.1. Artistic behaviors

1. O Luís foi a uma tertúlia sobre literatura francesa.

2. O João desenha e faz a sua própria roupa.

3. O Pedro entrou para um grupo de teatro amador.

4. O Pedro não perdeu a exposição de pintura.

1.2. Intelligent behaviors

1. O António venceu um torneio de xadrez com mais de 50 participantes.

2. O Pedro respondeu facilmente a todas as objecções que lhe colocaram.

3. O António aprendeu rapidamente a trabalhar com um programa de computador.

4. O Luís assistiu a uma conferências sobre biologia genética.

1.3. Ecollogical behaviors

1. O Luís anda a pé ou de bicicleta para minimizar a poluição.

2. O João participou em acções de limpeza de praias e matas.

3. O António foi a uma reunião da associação ambientalista de que faz parte.

4. O Luís separa o lixo doméstico para reciclar.

1.4. Friendly behaviors

1. O João ajudou a encontrar os pais de uma criança que se tinha perdido.

2. O Pedro perdeu uma hora a conversar com um colega que estava deprimido.

3. O João deu boleia a um condutor que tinha ficado sem gasolina.

4. O António ofereceu-se para tomar conta dos gatos do amigo.

1.5. Version 1 of the stimulus list

1. O Luís foi a uma tertúlia sobre literatura francesa.

- *Target: Luís / Trait: Artistic*

2. O António venceu um torneio de xadrez com mais de 50 participantes.

- *Target: António / Trait: Intelligent*

3. O Luís anda a pé ou de bicicleta para minimizar a poluição.

- *Target: Luís / Trait: Ecological*
- ***Block: non-successive inter-target***

4. O Pedro respondeu facilmente a todas as objecções que lhe colocaram.

- *Target: Pedro / Trait: Intelligent*
- ***Block: non-successive intra-target***

5. O João desenha e faz a sua própria roupa.

- *Target: João / Trait: Artistic*
- ***Block: successive intra-target***

6. O João ajudou a encontrar os pais de uma criança que se tinha perdido.

- *Target: João / Trait: Friendly*
- ***Block: successive intra-target***

7. O João participou em acções de limpeza de praias e matas.

- *Target: João / Trait: Ecological*
- ***Block: successive intra-target***

8. O António aprendeu rapidamente a trabalhar com um programa de computador.

- *Target: António / Trait: Intelligent*
- ***Block: non-successive inter-target***

9. O Pedro perdeu uma hora a conversar com um colega que estava deprimido.

- *Target: Pedro / Trait: Friendly*
- ***Block: non-successive intra-target***

10. O Luís assistiu a uma conferências sobre biologia genética.

- *Target: Luís / Trait: Intelligent*
- ***Block: successive inter-target***

11. O António foi a uma reunião da associação ambientalista de que faz parte.

- *Target: António / Trait: Ecological*
- ***Block: successive inter-target***

12. O Pedro entrou para um grupo de teatro amador.

- *Target: Pedro / Trait: Artistic*
- ***Block: successive inter-target***

13. O João deu boleia a um condutor que tinha ficado sem gasolina.

- *Target: João / Trait: Friendly*
- ***Block: non-successive inter-target***

14. O Pedro não perdeu a exposição de pintura.

- *Target: Pedro / Trait: Artistic*
- ***Block: non-successive intra-target***

15. O António ofereceu-se para tomar conta dos gatos do amigo.

- *Target: António / Trait: Friendly*

16. O Luís separa o lixo doméstico para reciclar.

- *Target: Luís / Trait: Ecological*

Block positioning in the list of 16 behaviors – version 1:

		NSD	NSS	SS	SS	SS	NSD	NSS	SD	SD	SD	NSD	NSS		

- Block NS-D: Non-Successive, Different-target
- Block NS-S: Non-Successive, Same-target
- Block S-D: Successive, Different-target
- Block S-S: Successive, Same-target

1.6. Version 2 of the stimulus list

1. O Luís foi a uma tertúlia sobre literatura francesa.
    - *Target: Luís / Trait: Artistic*
2. O António venceu um torneio de xadrez com mais de 50 participantes.
    - *Target: António / Trait: Intelligent*
3. O Pedro não perdeu a exposição de pintura.
    - *Target: Pedro / Trait: Artistic*
    - ***Block: non-successive intra-target***
4. O João deu boleia a um condutor que tinha ficado sem gasolina.
    - *Target: João / Trait: Friendly*
    - ***Block: non-successive inter-target***
5. O Pedro entrou para um grupo de teatro amador.
    - *Target: Pedro / Trait: Artistic*
    - ***Block: successive inter-target***
6. O António foi a uma reunião da associação ambientalista de que faz parte.
    - *Target: António / Trait: Ecological*
    - ***Block: successive inter-target***
7. O Luís assistiu a uma conferências sobre biologia genética.
    - *Target: Luís / Trait: Intelligent*
    - ***Block: successive inter-target***
8. O Pedro perdeu uma hora a conversar com um colega que estava deprimido.
    - *Target: Pedro / Trait: Friendly*
    - ***Block: non-successive intra-target***

9. O António aprendeu rapidamente a trabalhar com um programa de computador.

- *Target: António / Trait: Intelligent*
- ***Block: non-successive inter-target***

10. O João participou em acções de limpeza de praias e matas.

- *Target: João / Trait: Ecological*
- ***Block: successive intra-target***

11. O João ajudou a encontrar os pais de uma criança que se tinha perdido.

- *Target: João / Trait: Friendly*
- ***Block: successive intra-target***

12. O João desenha e faz a sua própria roupa.

- *Target: João / Trait: Artistic*
- ***Block: successive intra-target***

13. O Pedro respondeu facilmente a todas as objecções que lhe colocaram.

- *Target: Pedro / Trait: Intelligent*
- ***Block: non-successive intra-target***

14. O Luís anda a pé ou de bicicleta para minimizar a poluição.

- *Target: Luís / Trait: Ecological*
- ***Block: non-successive inter-target***

15. O António ofereceu-se para tomar conta dos gatos do amigo.

- *Target: António / Trait: Friendly*

16. O Luís separa o lixo doméstico para reciclar.

- *Target: Luís / Trait: Ecological*

Block positioning in the list of 16 behaviors – version 2:

		NSS	NSD	SD	SD	SD	NSS	NSD	SS	SS	SS	NSS	NSD		

- Block NS-D: Non-Successive, Different-target
- Block NS-S: Non-Successive, Same-target
- Block S-D: Successive, Different-target
- Block S-S: Successive, Same-target

1.7. <u>Version 3 of the stimulus list</u>

1. O Luís foi a uma tertúlia sobre literatura francesa.

- *Target: Luís / Trait: Artistic*

2. O António venceu um torneio de xadrez com mais de 50 participantes.

- *Target: António / Trait: Intelligent*

3. O Luís assistiu a uma conferências sobre biologia genética.

- *Target: Luís / Trait: Intelligent*
- ***Block: non-successive inter-target***

4. O João desenha e faz a sua própria roupa.

- *Target: João / Trait: Artistic*
- ***Block: non-successive intra-target***

5. O Pedro respondeu facilmente a todas as objecções que lhe colocaram.

- *Target: Pedro / Trait: Intelligent*
- ***Block: successive intra-target***

6. O Pedro perdeu uma hora a conversar com um colega que estava deprimido.

- *Target: Pedro / Trait: Friendly*
- ***Block: successive intra-target***

7. O Pedro não perdeu a exposição de pintura.

- *Target: Pedro / Trait: Artistic*
- ***Block: successive intra-target***

8. O António foi a uma reunião da associação ambientalista de que faz parte.

- *Target: António / Trait: Ecological*
- ***Block: non-successive inter-target***

9. O João ajudou a encontrar os pais de uma criança que se tinha perdido.

- *Target: João / Trait: Friendly*
- ***Block: non-successive intra-target***

10. O Luís anda a pé ou de bicicleta para minimizar a poluição.

- *Target: Luís / Trait: Ecological*
- ***Block: successive inter-target***

11. O António aprendeu rapidamente a trabalhar com um programa de computador.

- *Target: António / Trait: Intelligent*
- ***Block: successive inter-target***

12. O João deu boleia a um condutor que tinha ficado sem gasolina.

- *Target: João / Trait: Friendly*
- ***Block: successive inter-target***

13. O Pedro entrou para um grupo de teatro amador.

- *Target: Pedro / Trait: Artistic*
- ***Block: non-successive inter-target***

14. O João participou em acções de limpeza de praias e matas.

- *Target: João / Trait: Ecological*
- ***Block: non-successive intra-target***

15. O António ofereceu-se para tomar conta dos gatos do amigo.

- *Target: António / Trait: Friendly*

16. O Luís separa o lixo doméstico para reciclar.

- *Target: Luís / Trait: Ecological*

Block positioning in the list of 16 behaviors – version 3:

		NSD	NSS	SS	SS	SS	NSD	NSS	SD	SD	SD	NSD	NSS		

- Block NS-D: Non-Successive, Different-target
- Block NS-S: Non-Successive, Same-target
- Block S-D: Successive, Different-target
- Block S-S: Successive, Same-target

1.8. Version 4 of the stimulus list

1. O Luís foi a uma tertúlia sobre literatura francesa.
   - *Target: Luís / Trait: Artistic*
2. O António venceu um torneio de xadrez com mais de 50 participantes.
   - *Target: António / Trait: Intelligent*
3. O João participou em acções de limpeza de praias e matas.
   - *Target: João / Trait: Ecological*
   - ***Block: non-successive intra-target***
4. O Pedro entrou para um grupo de teatro amador.
   - *Target: Pedro / Trait: Artistic*
   - ***Block: non-successive inter-target***
5. O João deu boleia a um condutor que tinha ficado sem gasolina.
   - *Target: João / Trait: Friendly*
   - ***Block: successive inter-target***
6. O António aprendeu rapidamente a trabalhar com um programa de computador.
   - *Target: António / Trait: Intelligent*
   - ***Block: successive inter-target***
7. O Luís anda a pé ou de bicicleta para minimizar a poluição.
   - *Target: Luís / Trait: Ecological*
   - ***Block: successive inter-target***
8. O João ajudou a encontrar os pais de uma criança que se tinha perdido.
   - *Target: João / Trait: Friendly*
   - ***Block: non-successive intra-target***

9. O António foi a uma reunião da associação ambientalista de que faz parte.

- *Target: António / Trait: Ecological*
- ***Block: non-successive inter-target***

10. O Pedro não perdeu a exposição de pintura.

- *Target: Pedro / Trait: Artistic*
- ***Block: successive intra-target***

11. O Pedro perdeu uma hora a conversar com um colega que estava deprimido.

- *Target: Pedro / Trait: Friendly*
- ***Block: successive intra-target***

12. O Pedro respondeu facilmente a todas as objecções que lhe colocaram.

- *Target: Pedro / Trait: Intelligent*
- ***Block: successive intra-target***

13. O João desenha e faz a sua própria roupa.

- *Target: João / Trait: Artistic*
- ***Block: non-successive intra-target***

14. O Luís assistiu a uma conferências sobre biologia genética.

- *Target: Luís / Trait: Intelligent*
- ***Block: non-successive inter-target***

15. O António ofereceu-se para tomar conta dos gatos do amigo.

- *Target: António / Trait: Friendly*

16. O Luís separa o lixo doméstico para reciclar.

- *Target: Luís / Trait: Ecological*

Block positioning in the list of 16 behaviors – version 4:

		NSS	NSD	SD	SD	SD	NSS	NSD	SS	SS	SS	NSS	NSD		

- Block NS-D: Non-Successive, Different-target
- Block NS-S: Non-Successive, Same-target
- Block S-D: Successive, Different-target
- Block S-S: Successive, Same-target

2. Instructions

2.1. General instructions

Bem vinda(o)! Desde já, obrigado pela sua colaboração. Nesta sessão irá participar numa experiência que se insere num projecto de doutoramento que está a ser levado a cabo no ISCTE. É de extrema importância para a fidelidade dos dados que:

- atenda cuidadosamente às instruções apresentadas
- execute as tarefas segundo as indicações dadas
- permaneça concentrada(o) e em silêncio durante todo o estudo

(Aguarde que o experimentador indique a tecla que deverá pressionar para dar início ao estudo)

2.2. Processing Goal instructions

i) Impression Formation

Esta experiência insere-se num campo de estudo da Psicologia Social que se designa por Formação de Impressões de Personalidade. O modo como formamos impressões de pessoas é um dos fenómenos mais fascinantes da nossa vida social. Esta temática tem dado origem a um vastíssimo campo de investigação, mas muito há ainda por descobrir... (Pressione a barra de espaços para passar ao ecrã de instruções seguinte) Nas nossas interacções sociais construímos impressões de outras pessoas a partir da informação que se encontra disponível à nossa volta, fazemo-lo sem qualquer esforço, de forma rápida, eficiente e espontânea. É impressionante como por vezes, partindo de muito pouca informação, conseguimos chegara a impressões extraordinariamente exactas. Este processo é-nos extremamente útil, tornando possível a nossa vivência social. (Pressione a barra de espaços para passar ao ecrã de instruções seguinte) Neste estudo será apresentada uma série de 16 comportamentos executados por 4 pessoas. Os comportamentos surgirão no ecrã do do computador de forma automática, estando disponíveis por alguns segundos. À medida que for lendo cada comportamento procure imaginar como é a pessoa que o desempenha, integrando de forma activa cada comportamento na impressão que vai desenvolvendo da pessoa que o executa. Procure manter-se concentrada(o) e atenta(o) durante toda a tarefa.(Pressione a barra de espaços para passar ao ecrã de instruções seguinte) Procure FORMAR UMA IMPRESSÃO coerente de cada pessoa (Aguarde que o experimentador indique a tecla que deverá pressionar para dar início à experiência.)

ii) Memorization

Esta experiência insere-se num cmpo de estudo que se designa por PROCESSO DE RECUPERAÇÃO MNÉSICA (MEMÓRIA). A forma como codificamos, armazenamos e recuperamos a informação a partir da memória é um dos fenómenos mais investigados pela ciência psicológica. Todos os nossos processos cognitivos têm por base informação recuperada a partir da memória. A temática da memória de frases que descrevem acções de todos os dias tem dado origem a um vastíssimo campo de investigação, mas há muito ainda por descobrir... (Pressione a barra de espaços para passar ao ecrã de instruções seguinte) Perceber a forma como armazenamos e recuperamos a informação de frases que descrevem acções quotidianas é fundamental para entender a complexidade dos processos cognitivos, pelo que o estudo da forma como memorizamos este tipo de informação é imperativo. (Pressione a barra de espaços para passar ao ecrã de instruções seguinte) Neste estudo será apresentada uma série de 16 frases. Essas frases surgirão no ecrã do computador de forma automática, estando disponíveis por alguns segundos. Procure memorizar as frases, repetindo-as mentalmente, posteriormente ser-lhe-á pedido para as recordar. Perante cada nova frase procure memorizá-la activamente. Procure manter-se concentrada(o) e atenta(o) durante toda a tarefa. (Pressione a barra de espaços para passar ao ecrã de instruções seguinte) Procure MEMORIZAR as frases que vão ser apresentadas. (Aguarde que o experimentador indique a tecla que deverá pressionar para dar início à experiência.)

iii) Memorization of Order

Esta experiência insere-se num campo de estudo que se designa por MEMÓRIA DE ORDEM. A forma como codificamos, armazenamos e recuperamos informação relativa à ordem com que as coisas acontecem é um dos fenómenos mais investigados pela ciência psicológica. Todos os nossos processos cognitivos têm por base informação cuja ordem de ocorrência é fundamental para compreendermos uma simples história com princípio, meio e fim, qualquer narrativa ou mesmo qualquer vivência. Especificamente, a temática da memória de ordem de frases que descrevem acções de todos os dias tem dado origem a um vastíssimo campo de investigação, mas muito há ainda por descobrir... (Pressione a barra de espaços para passar ao ecrã de instruções seguinte) Perceber a forma como armazenamos e recuperamos a informação relativa à ordem de apresentação de frases que descrevem acções quotidianas é fundamental para entender a complexidade dos processos cognitivos, pelo que o estudo da forma como memorizamos este tipo de informação é imperativo. (Pressione a barra de espaços para passar ao ecrã de instruções seguinte) Neste estudo será apresentada uma série de 16 frases. Essas frases surgirão no ecrã do computador de forma automática, estando disponíveis por alguns segundos. Procure memorizar a ordem das frases, repetindo-as mentalmente, posteriormente ser-lhe-á pedido para recordar a ordem com que foram apresentadas. Perante cada nova frase procure memorizar a sua posição na ordem activamente. Procure manter-se concentrada(o) e atenta(o) durante toda a tarefa. (Pressione a barra de espaços para passar ao ecrã de instruções seguinte) Procure MEMORIZAR A ORDEM com que as frases vão ser apresentadas. (Aguarde que o experimentador indique a tecla que deverá pressionar para dar início à experiência.)

2.3. Recall instructions

i) Order Measure

De seguida surgirão no ecrã do computador conjuntos de 3 frases das que foram apresentadas no primeiro momento desta investigação. A sua tarefa será a de ORDENAR essas frases de acordo com a sua sequência com que as viu inicialmente. (Pressione a barra de espaços para passar ao ecrã de instruções seguinte) Por exemplo:

- frase X
- frase Y
- frase Z

O que lhe pedimos é que escolha, primeiro, a frase que pensa ter sido apresentada em primeiro lugar das 3. De seguida, que seleccione a frase que julga ter sido apresentada em segundo lugar das 3. Por fim, que escolha a frase que pensa ter sido apresentada em último lugar das 3. (Pressione a barra de espaços para passar ao ecrã de instruções seguinte) Para seleccionar a frase que deseja, deverá escolher a letra que a antecede - cada frase é antecedida por uma letra. Caso deseje seleccionar uma dada frase em 1º lugar, deverá carregar na tecla correspondente à letra que antecede essa frase. Após ter dado a primeira resposta poderá pressionar a tecla correspondente à letra daquela que julga ter sido a frase apresentada em 2º lugar. Por fim, deverá proceder de igual forma para escolher a frase que terá sido apresentada em 3º e último lugar. (Pressione a barra de espaços para passar ao ecrã de instruções seguinte) As teclas que deverá utilizar são as seguintes: T Y U (Pressione a barra de espaços para passar ao ecrã de instruções seguinte) ORDENE SEMPRE AS FRASES DE ACORDO COM A SEQUÊNCIA COM QUE AS LEU ANTERIORMENTE.(Aguarde que o experimentador indique a tecla que deverá pressionar para dar início à experiência.)

ii) Item Measure

Neste momento vão aparecer no ecrã as frases descritivas dos comportamentos apresentadas no primeiro momento da experiência. A sua tarefa será a de IDENTIFICAR A PESSOA que realizou esse comportamento. (Pressione a barra de espaços para passar ao ecrã de instruções seguinte) Para identificar a pessoa que desempenhou um dado comportamento, deverá utilizar as teclas cujas letras correspondem à inicial do nome de cada uma das 4 pessoas. J - para João; A - para António; L - para Luís; P - para Pedro (Pressione a barra de espaços para passar ao ecrã de instruções seguinte) IDENTIFIQUE A PESSOA QUE DESEMPENHOU CADA UM DOS COMPORTAMENTOS QUE SERÃO APRESENTADOS EM SEGUIDA. (Aguarde que o experimentador indique a tecla que deverá pressionar para dar início à experiência.)

2.4. Final instructions

A sua participação neste estudo terminou. MUITO OBRIGADO! (Pedimos-lhe que aguarde em silêncio até que o experimentador dê por terminada a tarefa)

3. Dependent Variables

3.1. Order Measure

- There are 6 possible combinations to arrange a sequence of 3 items (or a block of 3 items). Using a matrix coding system we code for the correctness of each sequence (or block) taking into account the position of the each item in the sequence, in relation to the remaining items.

- 6 possible sequences:
  1. a b c
  2. a c b
  3. b a c
  4. b c a
  5. c a b
  6. c b a

- coding for the correctness of each sequence:
  1. **a b c**:

	a	b	c
a		1	1
b			1
c			

  - Index of order: 1+1+1 = **3**
  - notes:
    - the position of *a* is correct relatively to *b*, so in the *a* row, the cell corresponding to the *b* column has an *1*
    - the position of *a* is correct relatively to *c*, so in the *a* row, the cell corresponding to the *c* column has an *1*
    - the position of *b* is correct relatively to *c*, so in the *b* row, the cell corresponding to the *c* column has an *1*

2. **a c b**:

	a	b	c
a		1	1
b			0
c			

- Index of order: 1+1+0 = **2**
- note:
  - the position of *a* is correct relatively to *b* and *c*, so in the *a* row, the cells corresponding to the *b* and *c* columns both have *1*
  - the position of *b* is incorrect relatively to *c*, so in the *b* row, the cell corresponding to the *c* column has a *0*

3. **b a c**:

	a	b	c
a		0	1
b			1
c			

- Index of order: **2**

4. **b c a**:

	a	b	c
a		0	0
b			1
c			

- Index of order: **1**

5. **c a b**:

	a	b	c
a		1	0
b			0
c			

– Index of order: **1**

6. **c b a**:

	a	b	c
a		0	0
b			0
c			

– Index of order: **0**

– So, for each block of 3 items, the matrix produces a value between 0 and 3, representing the correctness of the sequence according to the original studied sequence. 0 corresponds to an absolutely incorrect sequence, whereas 3 corresponds to the most possible correct sequence.

3.2. Item Measure

- Participants have to identify the target of each behavior.

- Each block is constituted by three behaviors.

- Participants either make the target identification correctly (1), or incorrectly (0), for each behavior.

- For each block, the value in the source memory measure varies from 0 (three targets were wrongly identified) to 3 (the three targets were correctly identified):
  - 0 targets correctly identified: **0** (in the item measure)
  - 1 target correctly identified: **1** (in the item measure)
  - 2 targets correctly identified: **2** (in the item measure)
  - 3 targets correctly identified: **3** (in the item measure)

4. Test of Normality and Homogeneity of Variances

4.1. Normality

i) Item measure

Kolmogorov-Smirnov Test for Normal Distribution (exp1.sta)

	N	d	p
SOURCE-S-S	75	,2485	< ,01
SOURCE-NS-S	75	,2522	< ,01
SOURCE-S-D.	75	,2508	< ,01
SOURCE-NS-D	75	,2179	< ,01

ii) Order measure

Kolmogorov-Smirnov Test for Normal Distribution (exp1.sta)

	N	d	p
ORDER-S-S	75	,2256	< ,01
ORDER-NS-S	75	,2250	< ,01
ORDER-S-D.	75	,2267	< ,01
ORDER-NS-D	75	,1787	< ,05

4.2. Homogeneity of Variances

i) Item measure

Levene's Test for Homogeneity of Variances (exp1.sta)

	MS Effect	MS Error	F	p
SOURCE-S-S	,491096	,232014	2,116661	,127866
SOURCE-NS-S	,326268	,324735	1,004723	,371221
SOURCE-S-D	,634199	,210721	3,009665	,055551
SOURCE-NS-D	,039791	,323594	,122966	,884479

ii) Order measure

Levene's Test for Homogeneity of Variances (exp1.sta)

	MS Effect	MS Error	F	p
ORDER-S-S	,752980	,286789	2,625551	,079323
ORDER-NS-S	,211023	,249480	,845853	,433411
ORDER-S-D	,006682	,272880	,024488	,975817
ORDER-NS-D	,096697	,275803	,350601	,705460

1. Stimulus Material

1.1. Friendly behaviors

1. Ajudou uma senhora com um carrinho de bebé a descer umas escadas.

2. Perdeu uma hora a conversar com um amigo que estava deprimido.

3. Ofereceu-se para tomar conta dos gatos do amigo.

4. Parou o seu carro e ajudou um desconhecido a mudar um pneu.

5. Prestou-se a ajudar um desconhecido a empurrar o carro.

6. Ofereceu-se para substituir um colega que estava deprimido.

7. Ajudou um amigo a estudar para o exame.

8. Ajudou um desconhecido a encontrar uma rua.

9. Auxiliou um transeunte a apanhar os papéis que lhe tinham caído ao chão.

10. Desviou-se do seu caminho habitual para dar boleia a um colega do emprego.

11. Ofereceu, no autocarro, o seu lugar a uma pessoa idosa.

12. Telefonou a todos os amigos a desejar boas festas.

1.2. Neutral behaviors

1. Foi a uma loja de um centro comercial comprar uma camisola de lã.
2. Costuma tomar uma bebida às refeições.
3. Naquele dia levou o guarda-chuva.
4. Informou o taxista para onde queria ir.
5. No caminho para o emprego comprou uma revista para ler.
6. Olhou para o relógio para ver as horas.

2. Instructions

2.1. General instructions

Desde já, obrigado pela sua colaboração. Nesta sessão irá participar numa experiência que se insere num projecto de doutoramento que está a ser desenvolvido no ISCTE. É de extrema importância para a fidelidade dos dados que:

- atenda cuidadosamente às instruções apresentadas
- execute as tarefas segundo as indicações dadas
- permaneça concentrada(o) e em silêncio durante todo o estudo

2.2. Processing Goal instructions

i) Impression Formation

Esta experiência insere-se num campo de estudo da Psicologia Social que se designa por FORMAÇÃO DE IMPRESSÕES DE PERSONALIDADE. O modo como formamos impressões de pessoas é um dos fenómenos mais fascinantes da nossa vida social. Esta temática tem dado origem a um vastíssimo campo de investigação, mas muito há ainda por descobrir... Nas nossas interacções sociais construímos impressões de outras pessoas a partir da informação que se encontra disponível à nossa volta, fazemo-lo sem qualquer esforço, de forma rápida, eficiente e espontânea. É impressionante como por vezes, partindo de muito pouca informação, conseguimos chegar a impressões extraordinariamente exactas. Este processo é-nos extremamente útil, tornando possível a nossa vivência social. Neste estudo será apresentada uma série de comportamentos executados por uma pessoa. Os comportamentos surgirão no ecrã do computador de forma automática, estando disponíveis por alguns segundos. À medida que for lendo cada comportamento procure imaginar como é a pessoa que o desempenha, integrando de forma activa cada comportamento na impressão que vai desenvolvendo dessa pessoa. Procure manter-se concentrada(o) e atenta(o) durante toda a tarefa.

ii) Memorization

Esta experiência insere-se num campo de estudo que se designa por PROCESSOS DE RECUPERAÇÃO MNÉSICA (MEMÓRIA). A forma como codificamos, armazenamos e recuperamos informação a partir da memória é um dos fenómenos mais investigados pela ciência psicológica. Todos os processos cognitivos têm por base informação recuperada da memória. Este é, portanto, um vastíssimo campo de investigação, mas muito há ainda por descobrir... Perceber a forma como armazenamos e recuperamos informação de frases é fundamental para entender a complexidade dos processos cognitivos, pelo que, o estudo da forma como memorizamos este tipo de informação é imperativo. Neste estudo será apresentada uma série de 18 frases. Estas frases surgirão no ecrã do computador de forma automática, estando disponíveis por alguns segundos. Procure memorizar as frases, repetindo-as mentalmente, posteriormente ser-lhe-á pedido para as recordar. Perante cada nova frase procure memorizá-la activamente. Procure manter-se concentrada(o) e atenta(o) durante toda a tarefa.

iii) Memorization of Order

Esta experiência insere-se num campo de estudo que se designa por MEMÓRIA DE ORDEM. A forma como codificamos, armazenamos e recuperamos informação relativa à ordem com que as coisas acontecem é um dos fenómenos mais investigados pela ciência psicológica. Todos os nossos processos cognitivos têm por base informação cuja ordem de ocorrência é fundamental, seja para compreendermos uma simples história com princípio, meio e fim; um número de telefone ou mesmo qualquer vivência. Especificamente, a temática da memória da ordem de frases tem dado origem a um vastíssimo campo de investigação, mas muito há ainda por descobrir... Perceber a forma como armazenamos e recuperamos a informação relativa à ordem de apresentação de frases é fundamental para entender a complexidade dos processos cognitivos, pelo que, o estudo da forma como memorizamos este tipo de informação é imperativo. Neste estudo será apresentada uma série de 18 frases. Essas frases surgirão no ecrã do computador de forma automática, estando disponíveis por alguns segundos. Procure memorizar a ORDEM das frases, repetindo-as mentalmente, posteriormente ser-lhe-á pedido para recordar a ordem com que as frases foram apresentadas. Perante cada frase procure memorizar a sua ordem activamente, para tal deverá ensaiar mentalmente a frase antecedente. Procure manter-se concentrada(o) e atenta(o) durante toda a tarefa.

2.3. Recall instructions

Pedimos-lhe agora que se procure lembrar das frases que viu anteriormente. Para cada frase que se lembre, deverá indicar se essa frase se encontrava no 1º, 2º ou 3º terço da lista original. A sua tarefa consiste em:

1) Escrever as frases que se lembra (na folha de papel distribuída pelo experimentador)

2) Sempre que se lembrar de uma frase deverá indicar se essa frase se encontrava no 1º, 2º ou 3º terço da lista

Não se esqueça, sempre que se lembrar de uma frase deverá escrever se essa frase estava no início (1º terço), no meio (2º terço) ou no fim (3º terço) da lista que viu no primeiro momento deste estudo.

3. Dependent Variables

3.1. <u>Item Measure</u>

- Participants have to recall as many of the behaviors studied in the stimulus list as possible.

- The proportion of behaviors recalled in relation to the total amount of behaviors studied in the stimulus material (18) is calculated.

- For example, if a participant recalls 5 behaviors, the the value in the item measure is 0,28 (5/18 = 0.28). If the amount of recalled behaviors is 8, then the value in the order measure is 0.44 (8/18 = 0.44).

3.2. Order Measure

- For each of the recalled behaviors, participants have to select whether the behavior was presented in the first, second or third part of the stimulus list.

- At the end, for each participant there is a list of recalled behaviors and each behavior has been assigned to one of the thirds of the stimulus list.

- The proportion of correctly ordered behaviors, in relation to the amount of recalled behaviors, is then computed for each participant to generate a value that reflects how well the participant did the order judgment task.

- For example, if a participant recalls 5 behaviors and correctly attributes 4 out of 5 to the corresponding parts of the stimulus list, then the value of that participant in the order measure is 0.8 (4/5 = 0.8). If 8 behaviors are recalled, but only 2 out of 8 are correctly attributed to the corresponding thirds of the stimulus list, then the value in the order measure is 0.25 (2/8 = 0.25).

3.3. Chaining Measure

- Participants recall the information producing a sequence of items. The chaining measure looks at the likelihood that after recalling an item, participants will recall an item that was presented in an adjacent (either antecedent or subsequent) position in the stimulus list.

- The maximum amount of chaining possibilities corresponds to the total amount of recalled items minus 1 ($N - 1$).

- For example, in a string of 5 items, there are 4 possibilities to rely on chaining to retrieve items, that is, the second item may have been in an adjacent position in relation to the first item, the same regarding the third item in relation to the second, the fourth in relation to the third, and the fifth in relation to the fourth.

- The proportion of times chaining was used, in relation to the maximum amount of possible chaining ($N - 1$), is then computed for each participant to generate a value that reflects how much the participant relied on chaining to recall information.

4. Test of Normality and Homogeneity of Variances

4.1. <u>Normality</u>

i) Item measure

Kolmogorov-Smirnov Test for Normal Distribution (exp2.sta)

	N	d	p
ITEM	56	,1077	> ,20

ii) Order measure

Kolmogorov-Smirnov Test for Normal Distribution (exp2.sta)

	N	d	p
ORDER	56	,1122	> ,20

4.2. Homogeneity of Variances

i) Item measure

Levene's Test for Homogeneity of Variances (exp2.sta)

	MS Effect	MS Error	F	p
ITEM	,000262	,004922	,053176	,948263

ii) Order measure

Levene's Test for Homogeneity of Variances (exp2.sta)

	MS Effect	MS Error	F	p
ORDER	,013736	,019628	,699803	,501214

1. Stimulus Material

1.1. Intelligent behaviors

1. Created a new computer language.

2. Scored the highest on an exam in his Biology class.

3. Scored 100% on a surprise quiz in calculus class.

4. Won the chess tournament.

5. Won the science project award.

1.2. Kind/Friendly behaviors

1. Offered to help an elderly neighbor paint his house.

2. Volunteer his time as a big brother to a fatherless child.

3. Gave out toys to the Children's Hospital.

4. Offered his umbrella to a lady at the bus stop.

5. Gave a co-worker (colleague) a ride home.

1.3. Adventurous behaviors

1. Test drove a Porsche at 120 m.p.h..

2. Told his friend he was interested in backpacking across the U.S..

3. Decided to take the advanced mountain climbing class.

4. Tried to go surfing although the waves were enormous.

5. Explored a boarded up old house that every one said was haunted.

1.4. <u>Extraverted behaviors</u>

1. Was voted the most popular by classmates.

2. Organized the class reunion.

3. Ran for student office.

4. Had the lead role in the school play.

5. Conducted a class in assertiveness training.

2. Instructions

2.1. General instructions

Welcome! Thank you for participating in this experiment. It is important that you:

- Read the instructions carefully.
- Perform all the tasks according to the given instructions.
- *Stay concentrated and remain silent during the study.*

2.2. Processing Goal instructions

i) Impression Formation

This experiment is part of a research project on how people FORM PERSONALITY IMPRESSIONS of other people. The way we form impressions about people is one of the most fascinating phenomena of our daily social life. In our interactions we form impressions about people using the information available in a given context. We do it without effort, in a rapid, efficient and spontaneous way. It is remarkable that we can form such accurate impressions of people using so little information. This process is extremely useful, making possible the existence of social interactions. In this study, you will be presented with behaviors describing John. Try to form an impression of John using each behavior. The behaviors will be presented on the computer screen for 8 seconds. Read each behavior carefully trying to imagine John. You can try to integrate each behavior into your overall impression of John. Remain focused during the task. Press the <SPACE BAR> key to start seeing the behaviors.

ii) Memorization of Order

This experiment is part of a research project on the study of MEMORY. More specifically, we are interested how people MEMORIZE THE ORDER of sentences. The way we encode, store and retrieve information from memory is one of the most fascinating phenomena of human mental activity. All the cognitive processes of the human mind make use of information retrieved from memory. These processes are based on information in which the order of occurrence is important. To make sense about a simple story or just a telephone number, the order is an important element. The understanding of how people store and retrieve the order information of sentences is crucial in making sense about the complexity of cognitive processes. In this study, you will be presented with 20 sentences. Try to memorize the order of these sentences. The sentences will be presented on the computer screen for 8 seconds. Read each sentence carefully and try to memorize the order of it. At the end of the study you will be asked to remember these sentences in the order you have seen them. Remain focused during the task. Press the <SPACE BAR> key to start seeing the sentences.

2.3. Recall instructions

i) Free Recall

Finally, at this stage of the experiment we will ask you to type all the sentences (or "behaviors" in the IF conditions) that you saw at the beginning of the study. Type each sentence (or behavior) as they come to mind. After typing a sentence (or behavior), press the <Enter> key before typing the next sentence (or behavior). It is natural that you do not to remember all the sentences (or behaviors). However, try to remember as many as you can. If you do not remember the exact phrasing used in the sentence (or behavior) there is no problem, you can type the general notion that you think was present in the sentence (or behavior). Nevertheless, try to reproduce each sentence (or behavior) with all the accuracy that you can. Please type all the sentences (or behaviors). Press the <Enter> key before typing the next sentence. Press the <Esc> key if you are finished early.

ii) Ordered Recall

Finally, at this stage of the experiment we will ask you to type all the sentences (or behaviors) that you saw at the beginning of the study, in the sequence that they were presented. That is, try to recreate the sequence in which the sentences (or behaviors) were presented to you when you studied them. After typing a sentence (or behavior), press the <Enter> key before typing the next sentence (or behavior) in the sequence. It is natural that you do not to remember all the sentences (or behaviors). However, try to remember as many as you can. If you do not remember the exact phrasing used in the sentence (or behavior) there is no problem, you can type the general notion that you think was present in the sentence (or behavior). Nevertheless, try to reproduce the sequence and each sentence (or behavior) with all the accuracy that you can. Please type all the sentences in the sequence that they were presented. Press the <Enter> key before typing the next sentence. Press the <Esc> key if you are finished early.

3. Dependent Variables

3.1. Item Measure

- Participants have to recall as many of the behaviors studied in the stimulus list as possible.

- The proportion of behaviors recalled in relation to the total amount of behaviors studied in the stimulus material (20) is calculated.

- For example, if a participant recalls 5 behaviors, the the value in the item measure is 0.25 (5/20 = 0.25). If the amount of recalled behaviors is 8, then the value in the order measure is 0.40 (8/20 = 0.40).

3.2. Order Measure

- This index of order in an adaptation of the measure used in experiment 1, but here used in a much more dynamic setting. If in experiment 1 there were only 6 possible combinations to arrange a sequence of 3 items, in experiment 3, given that participants are asked to free recall the information, the sequences are not fixed (with 3 items as in experiment 1), but can vary between 2 and 20 items.

- The operating principle is, however, exactly the same. A matrix coding system is used to code for the correctness of each produced sequence, taking into account the position of the each item in relation to the remaining ones. The matrix that in experiment 1 was constituted by a fixed number of cells (3), originating always a value between 0 and 3, is extremely dynamic and it is constantly changing in the present experiment, varying from 1 cell (in the case of a sequence of 2 items), originating values from 0 and 1, and 190 cells (in the case of a sequence of 20 items), originating values from 0 to 190.

- Thus, the index used in the present experiment relies on proportions, correcting for the amount of cells in each matrix.

- The value in the order measure varies always between 0 and 1. Longer matrices bring higher discriminability to the measure, but the order measure is independent of item memory. For example, a sequence of 2 items is coded either as 0 or 1. A sequence with 3 items can be coded as 0, 0.33, 0.66, or 1.

- Examples of matrices:
  - sequence of 2 items:

	a	b
a		
b		

– sequence of 3 items:

	a	b	c
a			
b			
c			

– sequence of 20 items:

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t
a																				
b																				
c																				
d																				
e																				
f																				
g																				
h																				
i																				
j																				
k																				
l																				
m																				
n																				
o																				
p																				
q																				
r																				
s																				
t																				

4. Test of Normality and Homogeneity of Variances

4.1. Normality

i) Item measure

Kolmogorov-Smirnov Test for Normal Distribution (exp3.sta)

	N	d	p
ITEMFR	103	,1032	> ,20
ITEMOR	103	,1738	< ,10

ii) Order measure

Kolmogorov-Smirnov Test for Normal Distribution (exp3.sta)

	N	d	p
ORDERFR	103	,1114	> ,20
ORDEROR	103	,1796	< ,10

4.2. Homogeneity of Variances

i) Item measure

Levene's Test for Homogeneity of Variances (exp3.sta)				
	MS Effect	MS Error	F	p
ITEM	,262238	3,153622	,083154	,773658

ii) Order measure

Levene's Test for Homogeneity of Variances (exp3.sta)				
	MS Effect	MS Error	F	p
ORDER	,172436	,014959	11,52751	,000981

1. Stimulus Material

1.1. Irrelevant behaviors

1. Ate a cheeseburger for lunch.

2. Sharpened his pencil.

3. Bought a new album on Monday.

4. Bought a remote control for his television set.

5. Washed his car.

6. Biked home after class.

7. Took of his glasses.

8. Caught three trout on a weekend fishing trip.

9. Hung his poster on the wall.

10. Scratched his back.

11. Made a glass of tea after work.

12. Mailed a letter at the post office.

1.2. <u>Intelligent behaviors</u>

1. Scored in the 99th percentile on the GRE Exam.

2. Can speak four languages.

3. Graduated valedictorian of his high school class.

4. Discussed some new physics theories with his roommate.

5. Won the chess tournament.

6. Received a college scholarship.

1.3. Stupid behaviors

1. Left his windows open while washing his car.

2. Walked into the street without checking the oncoming traffic.

3. Failed his written drivers test for the fourth time.

4. Has to look up his own phone number occasionally.

5. Got lost several times taking the bus to work.

6. Locked himself out of his own house.

1.4. <u>Friendly behaviors</u>

1. Offered to help an elderly neighbor paint his house.

2. Volunteer his time as a big brother to a fatherless child.

3. Helped a man in a wheelchair cross a busy intersection.

4. Went downtown to meet and console a friend who was depressed.

5. Got coffee for his roommate who was studying.

6. Offered his umbrella to a lady at the bus stop.

1.5. Unfriendly behaviors

1. Wouldn’t talk to the secretaries except to ask favors.
2. Would not lend out any of his tools to the neighbors.
3. Refused to lend his extra pencil to another student.
4. Watched a short lady try to reach an item on the top shelf.
5. Smiled when a man tripped and almost fell down.
6. Demanded immediate service from the waitress.

2. Instructions

2.1. General instructions

Welcome! Thank you for participating in this experiment. It is important that you:

- Read the instructions carefully.
- Perform all the tasks according to the given instructions.
- Stay concentrated and remain silent during the study.

2.2. Processing Goal instructions

i) Impression Formation

This experiment is part of a research project on how people FORM PERSONALITY IMPRESSIONS of other people. The way we form impressions about people is one of the most fascinating phenomena of our daily social life. In our interactions we form impressions about people using the information available in a given context. We do it without effort, in a rapid, efficient and spontaneous way. It is remarkable that we can form such accurate impressions of people using so little information. This process is extremely useful making possible the existence of social interactions. In this study you will be presented with behaviors describing JOHN. Try to form an impression of JOHN using each behavior. The behaviors will be presented in the computer screen for 6 seconds each. Read each behavior carefully trying to imagine JOHN. You can try to integrate each behavior into your overall impression of JOHN. Remain focused during the task. Try to FORM AN IMPRESSION of JOHN. Read each behavior carefully trying to imagine this person.

ii) Memorization of Order

This experiment is part of a research project on the study of MEMORY. More specifically, we are interested how people MEMORIZE THE ORDER of sentences. The way we encode, store and retrieve information from memory is one of the most fascinating phenomena of human mental activity. All the cognitive processes of the human mind make use of information retrieved from memory. These processes are based on information in which the order of occurrence is important. To make sense about a simple story or just a telephone number, the order is an important element. The understanding of how people store and retrieve the order information of sentences is crucial in making sense about the complexity of cognitive processes. In this study, you will be presented with 18 sentences. Try to memorize the order of these sentences. The sentences will be presented on the computer screen for 6 seconds each. Read each sentence carefully and try to memorize the order of it. At the end of the study you will be asked to remember these sentences in the order you have seen them. Remain focused during the task. Press the <SPACE BAR> key to start seeing the sentences.

2.3. Expectancies

i) Intelligent

i.i. Impression Formation

To help you form an impression of JOHN we will give you some useful information about him. JOHN's friends describe him as an extremely intelligent, bright and gifted person. You may now begin to form your own impression of what John is like as a person.

i.ii. Memorization of Order

Here is some additional information to help you memorize the order of the sentence fragments. These sentence fragments describe a person. Some people that know this person describe this person as an extremely intelligent, bright and gifted person.

ii) Stupid

ii.i. Impression Formation

To help you form an impression of JOHN we will give you some useful information about him. JOHN's friends describe him as an extremely stupid, unintelligent and dull person. You may now begin to form your own impression of what John is like as a person.

ii.ii. Memorization of Order

Here is some additional information to help you memorize the order of the sentence fragments. These sentence fragments describe a person. Some people that know this person describe this person as an extremely stupid, unintelligent and dull person.

iii) Friendly

iii.i. Impression Formation

To help you form an impression of JOHN we will give you some useful information about him. JOHN's friends describe him as an extremely friendly, warm, and pleasant person. You may now begin to form your own impression of what John is like as a person.

iii.ii. Memorization of Order

Here is some additional information to help you memorize the order of the sentence fragments. These sentence fragments describe a person. Some people that know this person describe this person as an extremely friendly, warm and pleasant person.

iv) Unfriendly

iv.i. Impression Formation

To help you form an impression of JOHN we will give you some useful information about him. JOHN's friends describe him as an extremely unfriendly, cold and unpleasant. You may now begin to form your own impression of what John is like as a person.

iv.ii. Memorization of Order

Here is some additional information to help you memorize the order of the sentence fragments. These sentence fragments describe a person. Some people that know this person describe this person as an extremely unfriendly, cold and unpleasant person.

2.4. Recall instructions

i) Free Recall

Finally, at this stage of the experiment we will ask you to type ALL the sentences that you saw at the beginning of the study. Type each sentence as they come to mind. After typing a sentence, press the <Enter> key before typing the next sentence. It is natural that you do not remember all the sentences. However, try to remember as many as you can. If you do not remember the exact phrasing used in the sentence there is no problem, you can type the general notion that you think was present in the sentence. Nevertheless, try to reproduce each sentence with the maximum accuracy you can.

ii) Ordered Recall

Finally, at this stage of the experiment we will ask you to type ALL the sentences that you saw at the beginning of the study, in the sequence that they were presented. That is, try to recreate the sequence in which the sentences were presented to you when you studied them. After typing a sentence, press the <Enter> key before typing the next sentence in the sequence. It is natural that you do not remember all the sentences. However, try to remember as many as you can. If you do not remember the exact phrasing used in the sentence there is no problem, you can type the general notion that you think was present in the sentence. Nevertheless, try to reproduce the sequence and each sentence with the maximum accuracy you can.

3. Dependent Variables

3.1. Item Measure

- Participants have to recall as many of the behaviors studied in the stimulus list as possible.

- The proportion of behaviors recalled in relation to the total amount of behaviors studied in the stimulus material (18) is calculated.

- For example, if a participant recalls 5 behaviors, the the value in the item measure is 0.28 (5/18 = 0.28). If the amount of recalled behaviors is 8, then the value in the order measure is 0.44 (8/18 = 0.44).

3.2. Order Measure

- This index of order is the same as the one used in experiment 3. Participants are asked to free recall the information and so the sequences can vary between 2 and 18 items.

- A matrix coding system is used to code for the correctness of each produced sequence, taking into account the position of the each item in relation to the remaining ones. The matrix is extremely dynamic and it is constantly changing, varying from 1 cell (in the case of a sequence of 2 items), originating values from 0 and 1, and 153 cells (in the case of a sequence of 18 items), originating values from 0 to 153.

- The index used in the present experiment relies on proportions, correcting for the amount of cells in each matrix.

- The value in the order measure varies always between 0 and 1. Longer matrices bring higher discriminability to the measure, but the order measure is independent of item memory. For example, a sequence of 2 items is coded either as 0 or 1. A sequence with 3 items can be coded as 0, 0.33, 0.66, or 1.

- Examples of matrices:
  - sequence of 2 items:

	a	b
a		
b		

  - sequence of 3 items:

	a	b	c
a			
b			
c			

– sequence of 18 items:

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
a																		
b																		
c																		
d																		
e																		
f																		
g																		
h																		
i																		
j																		
k																		
l																		
m																		
n																		
o																		
p																		
q																		
r																		

4. Test of Normality and Homogeneity of Variances

4.1. Normality

i) Item measure

Kolmogorov-Smirnov Test for Normal Distribution (exp4.sta)

	N	d	p
ITEM	177	,1090	< ,05

ii) Order measure

Kolmogorov-Smirnov Test for Normal Distribution (exp4.sta)

	N	d	p
ORDER	177	,1048	< ,05

4.2. Homogeneity of Variances

i) Item measure

Levene's Test for Homogeneity of Variances (exp4.sta)				
	MS Effect	MS Error	F	p
ITEM	6,230164	2,691831	2,314471	,129980

ii) Order measure

Levene's Test for Homogeneity of Variances (exp4.sta)				
	MS Effect	MS Error	F	p
ORDER	,000329	,016987	,019397	,889395

1. Stimulus Material

1.1. Intelligent behaviors

1. Created a new computer language.

- Think about SIMILAR sentences to this one.
- Think about DIFFERENT sentences from this one.
- Think about the PREVIOUS sentence.

2. Successfully represented himself in court.

- Think about SIMILAR sentences to this one.
- Think about DIFFERENT sentences from this one.
- Think about the PREVIOUS sentence.

3. Scored the highest on an exam in his Biology class.

4. Scored 100% on a surprise quiz in calculus class.

5. Won the chess tournament.

6. Won the science project award.

1.2. Kind/Friendly behaviors

1. Offered to help an elderly neighbor paint his house.
    - Think about SIMILAR sentences to this one.
    - Think about DIFFERENT sentences from this one.
    - Think about the PREVIOUS sentence.
2. Helped a man in a wheelchair cross a busy intersection.
    - Think about SIMILAR sentences to this one.
    - Think about DIFFERENT sentences from this one.
    - Think about the PREVIOUS sentence.
3. Volunteer his time as a big brother to a fatherless child.
4. Offered his umbrella to a lady at the bus stop.
5. Gave out toys to the Children’s Hospital.
6. Gave a co-worker a ride home.

1.3. Adventurous behaviors

1. Told his friend he was interested in backpacking across the U.S..

- Think about SIMILAR sentences to this one.
- Think about DIFFERENT sentences from this one.
- Think about the PREVIOUS sentence.

2. Test drove a Porsche at 120 m.p.h..

- Think about SIMILAR sentences to this one.
- Think about DIFFERENT sentences from this one.
- Think about the PREVIOUS sentence.

3. Decided out of the blue to catch a plane and surprise a friend.

4. Decided to take the advanced mountain climbing class.

5. Tried to go surfing although the waves were enormous.

6. Explored a boarded up old house that every one said was haunted.

1.4. Extraverted behaviors

1. Ran for student office.

- Think about SIMILAR sentences to this one.
- Think about DIFFERENT sentences from this one.
- Think about the PREVIOUS sentence.

2. Organized the class reunion.

- Think about SIMILAR sentences to this one.
- Think about DIFFERENT sentences from this one.
- Think about the PREVIOUS sentence.

3. Was voted the most popular by classmates.

4. Had the lead role in the school play.

5. Tried to talk to everyone at the party.

6. Conducted a class in assertiveness training.

2. Instructions

2.1. <u>General instructions:</u>

Welcome! Thank you for participating in this experiment. It is important that you:

- Read the instructions carefully.
- Perform all the tasks according to the given instructions.
- Stay concentrated and remain silent during the study.

2.2. Processing Goal instructions

i) Impression Formation

This experiment is part of a research project on how people FORM PERSONALITY IMPRESSIONS of other people. The way we form impressions about people is one of the most fascinating phenomena of our daily social life. In our interactions we form impressions about people using the information available in a given context. We do it without effort, in a rapid, efficient and spontaneous way. It is remarkable that we can form such accurate impressions of people using so little information. This process is extremely useful, making possible the existence of social interactions. In this study, you will be presented with sentences describing JOHN. Try to form an impression of JOHN using each sentence. The sentences will be presented on the computer screen for 6 seconds each. Read each sentence carefully trying to imagine JOHN. You can try to integrate each sentence into your overall impression of JOHN. To help you form an impression of JOHN you will be asked to compare some sentences with similar/different/the previous sentences. That is, to compare some sentences with the previous sentences that had a similar/different meaning. That is, to compare some sentences with the antecedent sentence. Remain focused during the task. Press the <SPACE BAR> key to start seeing the sentences.

ii) Memorization of Order

This experiment is part of a research project on the study of MEMORY. More specifically, we are interested how people MEMORIZE THE ORDER of sentences. The way we encode, store and retrieve information from memory is one of the most fascinating phenomena of human mental activity. All the cognitive processes of the human mind make use of information retrieved from memory. These processes are based on information in which the order of occurrence is important. To make sense about a simple story or just a telephone number, the order is an important element. The understanding of how people store and retrieve the order information of sentences is crucial in making sense about the complexity of cognitive processes. In this study, you will be presented with 20 sentences. Try to memorize the order of these sentences. The sentences will be presented on the computer screen for 6 seconds each. Read each sentence carefully and try to memorize the order of it. At the end of the study you will be asked to remember these sentences in the order you have seen them. Remain focused during the task. Press the <SPACE BAR> key to start seeing the sentences.

iii) Different Processing Goal instructions – impression formation:

- Think about SIMILAR sentences to this one.
- Think about DIFFERENT sentences from this one.
- Think about the PREVIOUS sentence.

2.3. Recall instructions

i) Free Recall

Finally, at this stage of the experiment we will ask you to type ALL the sentences that you saw at the beginning of the study. Type each sentence as they come to mind. After typing a sentence, press the <Enter> key before typing the next sentence. It is natural that you do not remember all the sentences. However, try to remember as many as you can. If you do not remember the exact phrasing used in the sentence there is no problem, you can type the general notion that you think was present in the sentence. Nevertheless, try to reproduce each sentence with the maximum accuracy you can.

ii) Ordered Recall

Finally, at this stage of the experiment we will ask you to type ALL the sentences that you saw at the beginning of the study, in the sequence that they were presented. That is, try to recreate the sequence in which the sentences were presented to you when you studied them. After typing a sentence, press the <Enter> key before typing the next sentence in the sequence. It is natural that you do not remember all the sentences. However, try to remember as many as you can. If you do not remember the exact phrasing used in the sentence there is no problem, you can type the general notion that you think was present in the sentence. Nevertheless, try to reproduce the sequence and each sentence with the maximum accuracy you can.

3. Dependent Variables

3.1. Item Measure

- Participants have to recall as many of the behaviors studied in the stimulus list as possible.

- The proportion of behaviors recalled in relation to the total amount of behaviors studied in the stimulus material (24) is calculated.

- For example, if a participant recalls 5 behaviors, the the value in the item measure is 0.21 (5/24 = 0.21). If the amount of recalled behaviors is 8, then the value in the order measure is 0.33 (8/24 = 0.33).

3.2. Order Measure

- This index of order is the same as the one used in experiment 3 and 4. Participants are asked to free recall the information and so the sequences can vary between 2 and 24 items.

- A matrix coding system is used to code for the correctness of each produced sequence, taking into account the position of the each item in relation to the remaining ones. The matrix is extremely dynamic and it is constantly changing, varying from 1 cell (in the case of a sequence of 2 items), originating values from 0 and 1, and 276 cells (in the case of a sequence of 24 items), originating values from 0 to 276.

- The index used in the present experiment relies on proportions, correcting for the amount of cells in each matrix.

- The value in the order measure varies always between 0 and 1. Longer matrices bring higher discriminability to the measure, but the order measure is independent of item memory. For example, a sequence of 2 items is coded either as 0 or 1. A sequence with 3 items can be coded as 0, 0.33, 0.66, or 1.

- Examples of matrices:
  - sequence of 2 items:

	a	b
a		
b		

  - sequence of 3 items:

	a	b	c
a			
b			
c			

– sequence of 24 items:

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x
a																								
b																								
c																								
d																								
e																								
f																								
g																								
h																								
i																								
j																								
k																								
l																								
m																								
n																								
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r																								
s																								
t																								
u																								
v																								
w																								
x																								

4. Test of Normality and Homogeneity of Variances

4.1. Normality

i) Item measure

Kolmogorov-Smirnov Test for Normal Distribution (exp5.sta)

	N	d	p
ITEM	159	,1014	< ,10

ii) Order measure

Kolmogorov-Smirnov Test for Normal Distribution (exp5.sta)

	N	d	p
ORDER	159	,0946	< ,15

4.2. Homogeneity of Variances

i) Item measure

Levene's Test for Homogeneity of Variances (exp5.sta)				
	MS Effect	MS Error	F	p
ITEM	4,010895	3,676625	1,090917	,363087

ii) Order measure

Levene's Test for Homogeneity of Variances (exp5.sta)				
	MS Effect	MS Error	F	p
ORDER	,142119	,017086	8,317941	,000004

1. Stimulus Material

1.1. Intelligent behaviors

1. Created a new computer language.

2. Scored the highest on an exam in his Biology class.

3. Scored 100% on a surprise quiz in calculus class.

4. Won the chess tournament.

5. Won the science project award.

6. Successfully represented himself in court.

1.2. Kind/Friendly behaviors

1. Offered to help an elderly neighbor paint his house.

2. Volunteer his time as a big brother to a fatherless child.

3. Gave out toys to the Children's Hospital.

4. Helped a man in a wheelchair cross a busy intersection.

5. Offered his umbrella to a lady at the bus stop.

6. Gave a co-worker a ride home.

1.3. Adventurous behaviors

1. Test drove a Porsche at 120 m.p.h..

2. Decided out of the blue to catch a plane and surprise a friend.

3. Told his friend he was interested in backpacking across the U.S..

4. Decided to take the advanced mountain climbing class.

5. Tried to go surfing although the waves were enormous.

6. Explored a boarded up old house that every one said was haunted.

1.4. Extraverted behaviors

1. Was voted the most popular by classmates.

2. Organized the class reunion.

3. Ran for student office.

4. Had the lead role in the school play.

5. Tried to talk to everyone at the party.

6. Conducted a class in assertiveness training.

2. Instructions

2.1. <u>General instructions:</u>

Welcome! Thank you for participating in this experiment. It is important that you:

- Read the instructions carefully.
- Perform all the tasks according to the given instructions.
- Stay concentrated and remain silent during the study.

2.2. Processing Goal instructions:

i) Impression Formation

This experiment is part of a research project on how people FORM PERSONALITY IMPRESSIONS of other people. The way we form impressions about people is one of the most fascinating phenomena of our daily social life. In our interactions we form impressions about people using the information available in a given context. We do it without effort, in a rapid, efficient and spontaneous way. It is remarkable that we can form such accurate impressions of people using so little information. This process is extremely useful, making possible the existence of social interactions. In this study, you will be presented with sentences describing JOHN. Try to form an impression of JOHN using each sentence. The sentences will be presented on the computer screen for 6 seconds each. Read each sentence carefully trying to imagine JOHN. You can try to integrate each sentence into your overall impression of JOHN. Remain focused during the task. Press the <SPACE BAR> key to start seeing the sentences.

ii) Memorization of Order

This experiment is part of a research project on the study of MEMORY. More specifically, we are interested how people MEMORIZE THE ORDER of sentences. The way we encode, store and retrieve information from memory is one of the most fascinating phenomena of human mental activity. All the cognitive processes of the human mind make use of information retrieved from memory. These processes are based on information in which the order of occurrence is important. To make sense about a simple story or just a telephone number, the order is an important element. The understanding of how people store and retrieve the order information of sentences is crucial in making sense about the complexity of cognitive processes. In this study, you will be presented with 20 sentences. Try to memorize the order of these sentences. The sentences will be presented on the computer screen for 6 seconds each. Read each sentence carefully and try to memorize the order of it. At the end of the study you will be asked to remember these sentences in the order you have seen them. Remain focused during the task. Press the <SPACE BAR> key to start seeing the sentences.

2.3. Directed forgetting instructions:

i) Forget

i.i. Impression Formation

The sentences you just saw were practice sentences for the critical sentences that will now be presented. Please disregard the sentences you saw and form an impression of JOHN based on the next set of critical sentences that will be presented.

i.ii. Memorization of Order

The sentences you just saw were practice sentences for the critical sentences that will now be presented. Please disregard the sentences you saw and memorize the order of the next set of critical sentences that will be presented.

ii) Remember

ii.i. Impression Formation

You finished seeing part of the sentences describing JOHN, about whom you have to form an impression. Now you will be presented with remaining sentences describing JOHN. Keep forming an impression of JOHN also based on the next sentences that will be presented.

ii.ii. Memorization of Order

You finished seeing part of the sentences for which you have to memorize the order. Now you will be presented with the remaining sentences. Keep memorizing the order of the next sentences that will be presented.

2.4. Recall instructions

i) Free Recall

i.i. Remember

Finally, at this stage of the experiment we will ask you to type ALL the sentences that you saw at the beginning of the study. Type each sentence as they come to mind. After typing a sentence, press the <Enter> key before typing the next sentence. It is natural that you do not remember all the sentences. However, try to remember as many as you can. If you do not remember the exact phrasing used in the sentence there is no problem, you can type the general notion that you think was present in the sentence. Nevertheless, try to reproduce each sentence with the maximum accuracy you can.

i.ii. Forget

Finally, at this stage of the experiment we will ask you to type ALL the sentences that you saw at the beginning of the study. Type the sentences that were presented both before and after the instruction to disregard the first set of sentences that was presented. We want you to try to remember the sentences from BOTH lists. Type each sentence as they come to mind. After typing a sentence, press the <Enter> key before typing the next sentence. It is natural that you do not remember all the sentences. However, try to remember as many as you can. If you do not remember the exact phrasing used in the sentence there is no problem, you can type the general notion that you think was present in the sentence. Nevertheless, try to reproduce each sentence with the maximum accuracy you can.

ii) Ordered Recall

ii.i. Remember

Finally, at this stage of the experiment we will ask you to type ALL the sentences that you saw at the beginning of the study, in the sequence that they were presented. That is, try to recreate the sequence in which the sentences were presented to you when you studied them. After typing a sentence, press the <Enter> key before typing the next sentence in the sequence. It is natural that you do not remember all the sentences. However, try to remember as many as you can. If you do not remember the exact phrasing used in the sentence there is no problem, you can type the general notion that you think was present in the sentence. Nevertheless, try to reproduce the sequence and each sentence with the maximum accuracy you can.

ii.ii. Forget

Finally, at this stage of the experiment we will ask you to type ALL the sentences that you saw at the beginning of the study, in the sequence that they were presented. Type the sentences that were presented both before and after the instruction to disregard the first set of sentences that was presented. We want you to try to remember the sequence of sentences from BOTH lists. After typing a sentence, press the <Enter> key before typing the next sentence in the sequence. It is natural that you do not remember all the sentences. However, try to remember as many as you can. If you do not remember the exact phrasing used in the sentence there is no problem, you can type the general notion that you think was present in the sentence. Nevertheless, try to reproduce the sequence and each sentence with the maximum accuracy you can.

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4. Test of Normality and Homogeneity of Variances

4.1. <u>Normality</u>

i) Item measure

Kolmogorov-Smirnov Test for Normal Distribution (exp6.sta)

	N	d	p
ITEM	176	,0883	< ,15

ii) Order measure

Kolmogorov-Smirnov Test for Normal Distribution (exp6.sta)

	N	d	p
ORDER	176	,0942	< ,10

4.2. Homogeneity of Variances

i) Item measure

Levene's Test for Homogeneity of Variances (exp6.sta)				
	MS Effect	MS Error	F	p
ITEM	,104370	3,853885	,027082	,869477

ii) Order measure

Levene's Test for Homogeneity of Variances (exp6.sta)				
	MS Effect	MS Error	F	p
ORDER	4,247498	3,229116	1,315375	,253035