Memory for Serial Order in Social Cognition: Does Order Matter When We Are Forming Impressions About Strangers?

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Abstract

The systematic study of memory for serial order has yet to find its niche in social cognition. According to the person memory literature, the organizational process underlying impression formation results in a network of associative links between information nodes (behaviors and traits) representing the target. This representation should facilitate the recall of source information and impair the recall of order information. The present study shows that both order and source information were better recalled under impression formation conditions, suggesting that the representation of a target person tends to preserve the relative position of events in a time sequence.

Keywords: Person memory; memory for serial order; impression formation; item information; order information.

Memory For Serial Order

The study of serial order effects is one of the main topics in human memory. In fact, much of our cognitive performance that uses memory involves the compilation of information pieces whose order of occurrence is determinant. For example, did Suzanne start avoiding me before, or after, I confuse a Malévitch's masterpiece with the museum background wall? Who did what (to whom) and who did it first, that is, the order in which the elements of the puzzle took place. It seems that the position of a given behavior in a time sequence is not trivial to the perceiver's emergent impression.

Theories of Memory For Serial Order

There are three major ways of conceptualizing serial order effects in the study of human memory (Henson, 1998, 1999; Lewandowsky & Murdoch, 1989). First, Positional Theory (Figure 1A) states that order information is stored associating each element to its position in a sequence, being retrieved by the use of each position to reach its associated element – item-position associations. The *Start-End Model* (Henson, 1998), a foremost model representing positional ideas, states that positional information is encoded as a function of the item's distance from the start and the end of a sequence.

Secondly, according to the Ordinal Theory (Figure 1B), the elements of a sequence can be represented in a unique dimension. Order is defined by each element's relative strength in that dimension – ordinal representations. An iteractive process recovers order information selecting the strongest element and then suppressing it. The *Perturbation Model*, presented by Estes (1972), is one of the leading proposals in the field, especially after recent developments that extend the original model from short-term to long-term memory effects (Estes, 1997; Nairne, 1992). Items are encoded in terms of their perceptual and temporal attributes, the value of the temporal attribute for any item is given by its strength relative to the beginning of the list. There is some probability that the encoding of an item may suffer some perturbation as consequence of random noise in the system.

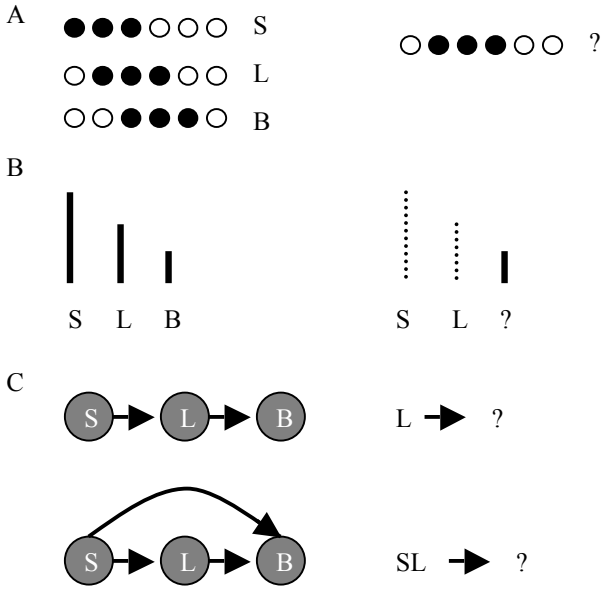

Figure 1: Storage and retrieval of a sequence *SLB:* (A) positional model of Burgess and Hitch (1992), (B) ordinal model of Page and Norris (1998), and (C) simple (Ebbinghaus, 1885/1913) and compound (based on Henson, 1998) chaining models.

Finally, Chaining Theory (Figure 1C) suggests that order is stored by the formation or strengthening of associations between successive elements in a list. Order is retrieved examining through the elements of the sequence – inter-item associations. Simple versions of these models only assume associations between pairs of elements in sequential positions in the list. Compound models, however, represent remote associations between items in non-successive positions in a list. This development overcame the key criticism concerning chaining models – *the chain becomes stronger than its weakest element* (Mewhort, Popham & James, 1994).

The *Theory of Distributed Associative Memory* (TODAM, Lewandowsky & Li, 1994; Lewandowsky & Murdoch, 1989; Murdoch, 1993, 1995, 1997) based on the notion of associative chaining seems to be the most prominent theoretical proposal in the literature. As the large majority of models about memory for serial order, TODAM has been stressing the distinction between item information and order information. Moreover, TODAM emphasizes the difference between three types of information: (a) item information allows the recall or recognition of single objects or events; (b) associative information underlies the recognition or recall of pair of objects/items; and (c) serial order information preserves the temporal order information in a sequence. This distinction, which seems critical, remains absent in the social cognition literature.

Another topic that has been enjoying recrudescent attention from many scholars in the field is the study of order in the context of autobiographical memories (Burt, Kemp, Grady & Conway, 2000; Friedman, 2004; Skowronski, Walker & Betz, 2003). Research on autobiographical memory has been focusing on the way individuals recall dates for past events (Kemp & Burt, 1998), the correspondent dating biases (Rubin & Baddeley, 1989) and dating processes (Friedman, 1993). But one thing is dating errors (events A and B are dated more recently than they actually occurred), and another thing is the distortion of the true order of the events (Burt, Kemp, Grady & Conway, 2000). This possible independence of "knowing what" and "knowing when" is very important given the emphasis on the reconstruction of temporal information from event memory (Friedman, 2004; Skowronski, Walker & Betz, 2003). Autobiographical memory tends to deal with complex events leaving out the processing of social information in impression formation framework. Therefore, it is more concerned with time than order, whereas the present research is more interested in memory for serial order.

Person Memory

In social cognition, specifically in impression formation literature, the systematic study of memory for serial order has not been seriously regarded, though many order output effects are very well known (e.g. primacy and recency effects, e.g. Asch, 1946).

In this literature there is an overwhelming dominance of associative network models in comparison to other types of representations (Garcia-Marques & Hamilton, 1996; Garcia-Marques, Hamilton & Maddox, 2002; Hamilton & Garcia-Marques, 2003; Hastie, 1980, 1988; Smith, 1998, 2004; Wyer & Srull, 1989). These models share the same representational and retrieval assumptions with the chaining theory – information is represented by the formation of associative links between items, being retrieved using these associations to reach the next item to be retrieved. Therefore, it seems that chaining and associative network models are compatible.

Hamilton, Katz and Leirer (1980a) describe an impression as a cognitive representation of a person. According to associative person memory models the organizational process underlying impression formation is very dynamic. During encoding, each element of information will be integrated with items previously known in the emergent impression (Hamilton, Katz & Leirer, 1980b). The resultant cognitive representation, defined as a network of associative links[1] (Sherman & Hamilton, 1994), should facilitate the recall of item information in impression formation conditions, but make the recall of order information more difficult, since this organization disrupts the order of presentation of the behaviors. As such, a direct comparison between an impression formation and a memorization goal condition (without this organizational component) should highlight the difference in the amount of associative elaboration that characterizes these two tasks.

Study 1

We generally followed Hamilton, Katz & Leirer (1980a), but we presented participants with information relative to multiple targets. Furthermore, we included measures for both memory for order and source[2]. We expected that memory for source should be better recalled under an impression formation than memory goal due to the intra-target organizational process triggered by impression formation. Nevertheless, the opposite result was expected for memory for order of successive items, because this organizational process that occurs under impression formation should disrupt the natural sequence of information in the stimulus list. It was expected then, that

[1] Some authors (Klein & Loftus, 1990; Klein, Loftus & Schell, 1994; Sherman & Klein, 1994) contest the associative basis of the benefits of meaning making activities (as impression formation) on memory. Differences in processing goals could draw from different recall strategies or even be the outcome of differential encoding processes, as forming impressions would favor the conceptual encoding, whereas memory would favor the perceptual encoding of information (Sherman, Lee, Bessenhoff & Frost, 1998; Sherman, Conrey & Groom, 2004; von Hippel, Sekaquaptewa & Vargas, 1995).

[2] A measure of source information (Ehrenberg & Klauer, 2005; Garcia-Marques & Hamilton, 1996; Johnson, Hashtroudi, & Lindsay, 1993) was used instead of a measure of item information to avoid contamination problems that would emerge if we had used memory for order after memory for item, or vice-versa.

memory for the order of blocks of behaviors that have been presented successively would be better in memorization condition than in impression formation condition. In contrast we expected impression formation to outperform memory participants in their memory for order of blocks of behaviors that have been assigned to the same target because the intra-target organizational process facilitates the knowledge of the relative positions of intra-target behaviors.

Method

Participants 109 undergraduate students from Higher School for Applied Psychology (ISPA, Lisbon) were invited to participate in this experiment**.**

Design Participants were randomly assigned to the cells of a 2 (processing goals: impression formation set vs. memorization set) X 4 (replications of stimulus list: version 1, version 2, version 3 and version 4) X 2 (succession of behaviors: successive vs. non-successive) X 2 (nature of the target: intra-target vs. between-target) factorial mix design with the last two variables grouped within-subjects in the four versions of the stimulus list**.**

Material The material used in the study was developed and tested by Garrido, Garcia-Marques and Jerónimo (2004) and Jerónimo, Garcia-Marques and Garrido (2004), consisting in 32 behavioral descriptions of 4 targets (John, Louis, Anthony and Peter). Each target performed 8 behaviors. 16 of these 32 behavioral descriptions were organized, for the purpose of the study, in 4 blocks of 4 behaviors each, according to the combination of the variables *succession of behaviors* and *nature of the targets*. As so, there was (1) a block of 4 behaviors in successive positions in the stimulus list performed by the same target (SI); (2) a block of 4 behaviors in successive positions performed by different targets (SB); (3) a block of 4 behaviors in non-successive positions performed by the same target (NSI); and (4) a block of 4 behaviors in non-successive positions performed by different targets (NSB).

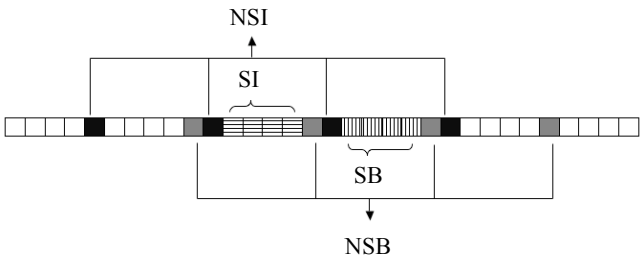

Figure 2: Position of the 4 blocks (SI, SE, NSI, NSE) in the stimulus list (32 items), according to the *1st version* of the material's replications

Procedure Participants were informed that they would take part in a study concerning impression formation (or memorization). The 32 behaviors were presented to the participants for 8 seconds each[3]. Afterwards subjects performed a distracter task. Finally they were asked to (1st) order the 4 behaviors of each block according to their position in the stimulus list, and (2nd) to identify the target that had performed each one of the 32 behaviors. The behaviors were presented randomly, both for order and source information.

Dependent Measures The dependent measures were (a) *memory for order*, a score between -3 and 3 that reflects the correction of the ordered behaviors in the blocks, and (b) *source memory*, a score that translates the number of critical items in which the target has been correctly retrieved for each of the 4 blocks.

Results and Discussion

Source memory The score of source memory was computed in a factorial mixed measures ANOVA with 2 (processing goals: impression formation set vs. memorization set) X 4 (replications of stimulus list: version 1, version 2, version 3 and version 4) X 2 (succession of behaviors: successive vs. non-successive) X 2 (nature of the targets: intra-target vs. between-target). The data show a main effect of the processing goal, t (101) = 1,91, p<0,03, illustrating, as predicted, that the target was better retrieved under impression formation goal conditions (M = 0,41) than under memorization goal conditions (M = 0,24). This effect was not moderated by any of the remaining variables.

Memory for Order Preliminary analysis showed that the participants performance in the successive behaviors was not different from random, F (1,97) = 0,05, p = 0,82 (M = 0,02). Thus, the two blocks of successive behaviors were omitted in subsequent analysis. The score of memory for order was computed in a three-way mixed measures ANOVA with 2 (processing goals: impression formation set vs. memorization set) X 4 (replications of stimulus list: version 1, version 2, version 3 and version 4) X 2 (nature of the targets: intra-target vs. between-target). This analysis shows the presence of a main effect for processing goal, F (1,99) = 6,28, p < 0,01, suggesting that participants performance in ordering behaviors was better under impression formation goal conditions (M = 0,69) in comparison to the memorization goal conditions (M = 0,23). This main effect in qualified by the nature of the targets, t (99) = 1,92, p < 0,03, which suggests better retrieval of order information in the intra-target behaviors for impression formation goal conditions (M = 0,86) if compared to the memorization goal conditions (M = 0,04), t (99) = 3,02, p <0,01. In what concerns between-target behaviors, results suggest no difference between impression formation (M = 0,52) and memorization goal conditions (M = 0,41), t (99) = 0,44, p = 0,66.

To summarize, results showed that source information was better recalled under impression formation conditions,

[3] Participants were not given any specific information concerning the chronological order of information in the stimulus list.

suggesting that intra-target organization did in fact occur. Moreover, memory for the order of intra-target behaviors was better in impression formation than in memory conditions, again suggesting intra-target organization. We found, however, no indication of better memory for order of successive behaviors under memory relative to impression formation conditions.

General Discussion

With this experiment we intended to start pursuing the study of memory for serial order in social cognition context. It seems that when social perceivers are encoding information in the social world, particularly, when they are trying to form an impression of a specific person, the order in which information is encoded could be a determinant element in the resulting cognitive representation of that given person.

We expected better performance of source memory under impression formation goal conditions comparing to the memorization goal conditions since the organizational process underlying impression formation should arrange information by target in memory. We expected the opposite effect for the memory of order of successive behaviors in the stimulus list, since the inexistence of the organizational process that characterizes impression formation, should help preserve the natural sequence of the information presented, and therefore, the representation of information in memorization goal conditions should be more similar to the sequence of the behaviors in the stimulus list. However, we expected that impression formation goal conditions would outperform memorization goal conditions for memory of order of the behaviors performed by the same target, because this information should be represented together in the unified representation of the person, preserving the information of the relative order of the behaviors in the sequence.

The main results can be synthesized as following. First, results show that participants retrieved more easily the target that had performed the behavior when they were forming impressions. These data replicate the effects found by Hamilton et al. (1980) and Garcia-Marques and Hamilton (1996) with a different measure, namely source memory instead of free recall. According to the mentioned authors, these data constitute strong evidence supporting the idea that forming an impression is organizing information in a way that attempts to make sense of a person. If that organized representation results in a pattern of inter-item associations, when we use the behavior to trigger the person node, there will be plenty of ways to access it.

Second, the results of memory for order seem to suggest that participant's performance is always better when they are forming impressions (contrarily to what was expected initially). The main explanation for this pattern of results is that serial order information was not preserved efficiently under both processing goals and order judgments, as such order judgments were based in associated cues. Since successive items share many of these cues, order judgment performance was impaired. The fact that this pattern was replicated across processing goals (we predicted this pattern for impression formation participants only) suggests that Memory participants spontaneously encoded the items in a way that was independent from serial order.

Third, in the case of non-successive behaviors, the results corroborated our contentions that memory for serial order would improve under impression formation relative to memory conditions for behaviors performed by the same target as a consequence of the integrative processes underlying impression formation.

Further research is greatly needed since the magnitude of the obtained effects was stumpy and the questions regarding the nature of the order cues used in person memory and the circumstances in which serial order information is preserved in person memory remains unanswered.

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References

Asch, S. E. (1946). Forming impressions of personality. *Journal of Abnormal and Social Psychology, 41*, 1230-1240.

Burgess, N., & Hitch, G. (1992). Toward a network model of the articulatory loop. *Jounal of Memory and Language, 31*, 429-460.

Burt, C. D. B., Kemp, S., Grady, J. M., & Conway, M. (2000). Ordering autobiographical experiences. *Memory, 8*, 323-332.

Ebbinghaus, H. (1885/1913). *Memory: A Contribution to Experimental Psychology*. New York: Columbia University, Teachers College.

Ehrenberg, K., & Klauer, K. C. (2005). Flexible use of source information: Processing components of the inconsistency effect in person memory. *Journal of Experimental Social Psychology, 41*, 369-387.

Estes, W. K. (1972). An associative basis for coding and organization in memory. In A. W. Melton & E. Martin (Eds.), *Coding processes in human memory* (pp. 161-190). Washington, DC: Winston.

Estes, W. K. (1997). Processes of memory loss, recovery, and distortion. *Psychological Review, 104*, 148-169.

Friedman, W. J. (1993). Memory for the time of past events. *Psychological Bulletin, 113*, 44-66.

Friedman, W. J. (2004). Time in autobiographical memory. *Social Cognition, 22*, 591-605.

Garcia-Marques, L., & Hamilton, D. L. (1996). Resolving the apparent discrepancy between the incongruency effect and the expectancy-based illusory correlation effect: The TRAP Model. *Journal of Personality and Social Psychology, 71*, 845-860.

Garcia-Marques, L., Hamilton, D. L., & Maddox, K. B. (2002). Exhaustive and heuristic retrieval processes in person cognition: Further tests of the TRAP Model.

Journal of Personality and Social Psychology, 82, 193-207.

Garrido, M., Garcia-Marques, L., & Jerónimo, R. (2004). Aventureiros, religiosos, ecológicos e artísticos: Pré-teste de descrições comportamentais. *Laboratório de Psicologia, 2*, 95-101.

Hamilton, D. L., & Garcia-Marques, L. (2003). Representation and retrieval in person memory, in G. V. Bodenhausen & A. J. Lambert (Eds.), *Foundations of Social Cognition: A Festschrift in Honor of Robert S. Wyer, Jr.* Hillsdale, NJ: Erlbaum.

Hamilton, D. L., Katz, L. B., & Leirer, V. (1980a). Organizational processes in impression formation. In R. Hastie, T. M. Ostrom, E. B. Ebbesen, R. S. Wyer, Jr., D. L. Hamilton, & D. E. Carlston (Eds.), *Person Memory: The Cognitive Basis of Social Perception* (pp. 121-154). Hillsdale, NJ: Lawrence Erlbaum Associates.

Hamilton, D. L., Katz, L. B., & Leirer, V. (1980b). Cognitive representation of personality impressions: Organizational processes in first impression formation. *Journal of Personality and Social Psychology, 39*, 1050-1063.

Hastie, R. (1980). Memory for behavioral information that confirms or contradicts a personality impression. In R. Hastie, T. M. Ostrom, E. B. Ebbesen, R. S. Wyer, Jr., D. L. Hamilton, & D. E. Carlston (Eds.), *Person Memory: The Cognitive Basis of Social Perception* (pp. 155-177). Hillsdale, NJ: Lawrence Erlbaum Associates.

Hastie, R. (1988). A computer simulation model of person memory. *Journal of Experimental Social Psychology, 24,* 423-447.

Hastie, R., Ostrom, T. M., Ebbesen, E. B., Wyer, R. S., Jr., Hamilton, D. L., & Carlston, D. E. (Eds.). (1980). *Person memory: The Cognitive Basis of Social Perception.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Henson, R. N. A. (1998). Short-term memory for serial order: The start-end model. *Cognitive Psychology, 36*, 73-137.

Henson, R. N. A. (1999). Coding position in short-term memory. *International Journal of Psychology, 34*, 403-409.

Jerónimo, R., Garcia-Marques, L., & Garrido, M. (2004). Comportamentos e traços de personalidade: Traços gerados para comportamentos de duas dimensões de personalidade. *Laboratório de Psicologia, 2* , 33-47.

Johnson, M. K., Hashtroudi, S., & Lindsay, D. S. (1993). Source monitoring. *Psychological Bulletin, 114*, 3-28.

Kemp, S., & Burt, C. D. B. (1998). Th force of events: Cross-modality matching the recency of news events. *Memory, 6*, 297-306.

Klein, S. B., & Loftus, J. (1990). Rethinking the role of organization in person memory. An independent trace storage model. *Journal of Personality and Social Psychology, 59*, 400-410.

Klein, S. B., Loftus, J., & Schell, T. (1994). Repeated testing: A technique for assessing the roles of elaborative and organizational processing in the representation of social knowledge. *Journal of Personality and Social Psychology, 66*, 830-839.

Lewandowski, S., & Li, S. C. (1994). Memory for serial order revisited. *Psychological Review, 101*, 539-543.

Lewandowski, S., & Murdoch, B. B. (1989). Memory for serial order. *Psychological Review, 96*, 25-57.

Mewhort, D. J. K., Popham, D., & James, G. (1994). On serial recall: A critique of chaining theory of distributed associative memory. *Psychological Review, 101*, 534-538.

Murdoch, B. B. (1993). TODAM 2: A model for the storage and retrieval of item, associative, and serial-order information. *Psychological Review, 100*, 183-203.

Murdoch, B. B. (1995). Developing TODAM: Three models for serial-order information. *Memory & Cognition, 23*, 631-645.

Murdoch, B. B. (1997). Context and mediators in a theory of distributed associative memory (TODAM 2). *Psychological Review, 104*, 839-862.

Nairne, J. S. (1992). The loss of positional certainty in long-term memory.*Psychological Science, 3*, 199-202.

Page, M. P. A., & Norris, N. G. (1998). The primacy model: A new model of immediate serial recall. *Psychological Review, 105 (4)*, 761-781.

Rubin, D. C., & Baddeley, A. D. (1989). Telescoping is not time compression: A model of the dating of autobiographical events. *Memory & Cognition, 17*, 653-661.

Sherman, J. W., Conrey, F. R., & Groom, C. J. (2004). Encoding flexibility revisited: Evidence for enhanced encoding of stereotype-inconsistent information under cognitive load. *Social Cognition, 22*, 214-232.

Sherman, J. W., & Hamilton, D. L. (1994). On the formation of interitem associative links in person memory. *Journal of Experimental Social Psychology, 30*, 203-217.

Sherman, J. W., & Klein, S. B. (1994). Development and representation of personality impressions. *Journal of Personality and Social Psychology, 67*, 972-983.

Sherman, J. W., Lee, A. Y., Bessenhoff, G. R., & Frost, L. A. (1998). Stereotype efficiency reconsidered: Encoding flexibility under cognitive load. *Journal of Personality and Social Psychology, 75*, 589-606.

Skowronski, J. J., Walker, W. R., & Betz, A. L. (2003). Ordering our world: An examination of time in autobiographical memory. *Memory, 11*, 247-260.

Smith, E. R. (1998). Mental representation and memory. In D. Gilbert, S. Fiske, & G. Lindzey (Eds.), *Handbook of Social Psychology.* 4th edn. Vol. 1 (pp, 391-445). New York: McGraw-Hill.

Smith, E. R., & Queller, S. (2004). Mental representations. In M. B. Brewer, & M. Hewstone (Eds.), *Social Cognition* (pp. 5-27). Oxford: Blackwell Publishing.

von Hippel., W. Sekaquaptewa, D., & Vargas, P. (1995). On the role of encoding processes in stereotype maintenance. *Advances in Experimental Psychology, 27*, 177-254.

Wyer, R. S., Jr., & Srull, T. K. (1989). *Memory and Cognition in its Social Context*. Hillsdale, NJ: Lawrence Erlbaum Associates.