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PROCESSING FLUENCY AND DECISION-MAKING: THE ROLE OF LANGUAGE STRUCTURE

This paper models conventionalisation of language structure as constitutive of processing fluency. I postulate that the difference in conventionalisation of linguistic forms used for communication significantly influences our reasoning about linguistically-expressed problems. Two studies are reported that tested this hypothesis with the use of variably conventionalised – fluent and disfluent – formulations of problem-solving tasks. The findings indicate that even in tasks requiring analytic reasoning, the degree to which the linguistic forms employed to communicate are conventionalised is correlated with the subjects' performance success rate. On a more general level, this paper seeks to empirically address the nature of links between linguistic form and meaning construction.

Key words: cognition, communication, conventionalisation, decision-making, dual-processing, fluency, meaning construction

Introduction

The present paper attempts to contribute to the growing body of research in cognitive science that demonstrates the considerable impact of presentation of material upon cognitive processes. These studies range from the investigation of the "framing effects", i.e. how different formulations of a problem lead to differences in decision-making (e.g. Tversky & Kahneman, 1981, 1986; Duchon, Dunegan, & Barton, 1989; Levin, Schneider, & Gaeth, 1998), to presentation in the more literal sense of how legible the font chosen for presentation is (Alter, Oppenheimer, Epley, & Eyre, 2007; Song & Schwarz, 2008b; Alter & Oppenheimer,

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2009). I will investigate the role that different degrees of processing fluency – modeled here as conventionalisation of linguistic forms used for communication (Langacker, 1987, 2008) – play in the decision-making procedure.

Language structure and meaning construction

A postulate associated with truth-conditional semantics (Davidson, 1967) is that the meaning of a sentence is the same as the conditions under which the sentence is true. In that framework expressions such as (1) and (2) would be taken to mean the same.

(1) You will pay around 5$ for the ticket.
(2) In order to get the ticket you will expend in the area of 5$.

In this paper I follow the line of linguistic inquiry proposed prominently by Cognitive Linguistics (Langacker, 1987, 1991; Lakoff & Johnson, 1980; Lakoff, 1987; Talmy, 2000), where "the formal structures of language are studied not as if they were autonomous, but as reflections of general conceptual organization, categorization principles, processing mechanisms, and experiential and environmental influences" (Geeraerts & Cuyckens, 2007: 3; cf. Geeraerts, 1995: 111). Cognitive linguists propose that meaning is best captured as conceptualisation – a dynamic mental process relying on encyclopaedic knowledge and grounded in the bodily experience of the conceptualiser.

In the meaning-as-conceptualisation proposal, language form plays an important role since the linguistic material offered by the addresser to the addressee is a trigger in the meaning-making process. Linguistic expressions are used for packaging conceptual content through the imposition of construals (Langacker, 1987, 2008). To impose construals is to portray a scene in a particular way, the assumption being that a single scene can be construed in many fashions. The parameters of construal – such as granularity (level of detail), prominence (governing how attention is allocated to elements of the scene), and perspective (what the relationship between the conceptualiser and the conceptualised is, e.g. if the conceptualised is structured as stationary or on the move) – can be variously calibrated and realised linguistically.

An indispensable supplement to the three construal parameters mentioned above is that of conventionalisation, for it functions as an overarching constraint and is a constitutive element in the working of construal parameters. That is to say, granularity, prominence, and perspective of construals coded in linguistic expressions are monitored by speakers with conventionalisation kept in mind as a governing principle. For instance, to answer a question like (3) the language user has an infinite range of response variants characterised by different resolution levels.

(3) "What happened to your hand?"

However, for the answer to be conventional, a declaration like (4) will typically be satisfactory, even though a less fine-grained response such as (5) or (6) and a more fine-grained one such as (7) can be equally felicitous in the truth-conditional semantic sense (i.e. investigating a proposition's meaning as reducible to conditions under which it is true in the real world).

(4) My cat scratched me.
(5) My cat.
(6) An animal did something to me.
(7) My three-year-old tabby cat scratched me as I was sitting on the sofa in my living room.

Still, the optimality of granularity choices will depend on a range of contextual factors, such as the background knowledge of the interlocutors. If both the speaker and the listener know the culprit cat, the response could be more specific and include the animal's name instead of the generic term.

As for prominence, if we wanted to communicate the composition of a scene involving "a branch" and "a butterfly" where they are in contact, it would be unconventional to construe the butterfly as a landmark and to profile the branch as the most prominent participant – as in (8) – because we are used to smaller and more mobile participants being construed as more salient (cf. Talmy, 2000: 315-316)

(8) There is a branch under the butterfly.

Coming to perspective, conventionalisation can be for instance adjusted in expressions that code temporality where (9) will arguably be acceptable but less conventional than (10). In the first utterance duration is structured spatially in terms of the traversed path and in the second utterance a more typical, temporal, unit of duration is given.

(9) She spoke non-stop from Naples to Salerno.
(10) She spoke non-stop for an hour.

Iconicity

The idea of seeing form as meaningful has been given scholarly attention under the label of "iconicity". Iconicity is understood as a relation of analogy between the form of a linguistic sign and its meaning. This brings us to the deliberations by Charles Sanders Peirce (1982, 1998) and the typology of signs. Peirce argued for a tripartite composition of a sign. In that framework, "sign" – which

is more unambiguously referred to as "representamen" or "representation" – is the sign's tangible manifestation. In the case of language, it would be the spoken acoustic signal or written language sample. Then there is the "object", which is understood as what is being signified. Third, "interpretant" is taken to stand for our comprehension of the link between the representamen and the object. Signs are then divided into three groups, depending on the relation between the representamen and the object (Peirce, 1982). An icon is a sign whose representation is interpreted as representing the object because there is a shared quality. If the link relies on a sensory experience that points to another entity, event, property, etc. – as is the case if the relation between the two is of causal nature (e.g. laughter and cheerfulness) – the sign is an index. In symbols the relation between the representation and the object is recognised by virtue of a convention, as there is no identifiable link that would bring them together otherwise.

Iconicity has long been seen as an idiosyncrasy of language use, present only in music and onomatopoeic linguistic expressions. Ferdinand de Saussure (1916) prominently argued for arbitrariness of the linguistic sign in the sense that the connection between the signified and the signifier is not motivated. More recently, however, convincing claims have been made arguing for motivatedness of language signs. Greenberg (1966: 103), for example, observed that the linguistic ordering of components is in accordance with the ordering of components as it is experienced in the outside world and the "order of knowledge". Therefore, the interpretation of (11) and (12) will be different because of how the clauses are ordered:

(11) She fell in love and got married.
(12) She got married and fell in love.

Another interesting case of iconicity in language could be termed speaker-centred proximity. In line with evidence from different languages, what is closer to the speaker tends to be placed earlier in the expression, both in the physical sense ("here and there", "this and that") and in the metaphorical sense, for instance in the domain of time ("sooner or later") (cf. Landsberg, 1995; Van Langendonck, 2007). In turn, Haiman (1983: 782) observes that conceptual proximity is mirrored by proximity in the physical sense. Van Langendock (2007: 407) gives the example of the following pair of variants, where the object's being more "affected" is correlated with its smaller distance from the verb:

(13) He smeared the wall with paint.
(14) He smeared paint on the wall.

With this in mind, in this paper I present empirical data to argue that the manner of linguistic presentation, i.e. the form that the speaker chooses to em-

ploy to prompt meaning construction in the addressee, plays an important role in the process, influencing problem-solving success rates.

Conventionalisation as (dis)fluency

To begin with, "conventionalisation" is understood as cognitive routinisation of a structure, or "how widely a structure is shared among speakers (and accepted as such)" (Langacker, 2007: 425). Some accounts further differentiate between conventionalisation and entrenchment (e.g. Langacker, 2008), in that the latter can be characterised for a particular language user while the former is a matter of a language community. With this in mind, we could therefore think of a linguistic construction that will be highly entrenched in a particular language user but at the same time will not be regarded as conventional by members of a language community that the speaker functions in. Even if this differentiation is used, the vital parameter shared by entrenchment and conventionalisation is that they are a matter of degree, and are reinforced by frequency of exposure and production (cf. Brown, 1965; Downing, 1977; Langacker, 1987: 59).

Fluency, then, is taken to stand for an individual's processing ease experienced while performing a mental operation. Connections have been found between fluency and aspects of cognition such as categorisation (Whittlesea & Leboe, 2000; Oppenheimer & Frank, 2007), memory performance (Diemand-Yauman, Oppenheimer, & Vaughan, 2011), truthfulness assessment (Reber & Schwarz, 1999; McGlone & Tofighbakhsh, 2000), likeability (Bornstein & D'Agostino, 1992; Reber et al., 1998), fame (Jacoby et al., 1989), effort prediction and motivation (Song & Schwartz, 2008a), as well as perception of risk (Song & Schwartz, 2009).

Notable fluency-modulating factors are primarily sensory in nature; for instance the visual clarity of stimuli, like the choice of font, in terms of its legibility (Shah & Oppenheimer, 2007; Song & Schwartz, 2008a; Alter & Oppenheimer, 2008; Diemand-Yauman, Oppenheimer, & Vaughan, 2011), as well as ease of pronunciation (Alter & Oppenheimer, 2006; Song & Schwartz, 2008a, 2009). This article intends to illustrate the affinity between the construct of "conventionalisation" – as formulated in linguistics literature (e.g. Langacker, 2008; Schmid, forthcoming) – and the construct of "fluency" – as addressed originally in psychology (e.g. Altern & Oppenheimer, 2009). The objective is to see how language-bound lexico-syntactic disfluency, or decreased conventionalisation, influences problem-solving.

Study 1

Study 1 was designed as an examination of whether the difference in the degree of conventionalisation will influence detection of anomaly. Specifically, I looked into how individuals respond to a case of semantic illusion (Erickson & Mattson, 1981; Park & Reder, 2003) depending on the degree of fluency of its phrasing.

The crucial property of a semantic illusion, also commonly referred to as "the Moses illusion", is that when confronted with them subjects tend to glide over the anomalous item and take it for granted that the question is well-formed. For instance, most people respond "two" when asked "How many animals of each kind did Moses take on the ark?" (Erickson & Mattson, 1981; Reder & Kusbit, 1991; Kamas et al., 1996), even though they are otherwise aware that the biblical name does not fit.

Disfluency has been demonstrated to positively influence identification of semantic illusions. Song and Schwartz (2008a) showed that a disfluent presentation of the distorted question resulted in higher distortion identification rate. The present study tested whether language-incurred disfluency analogously benefits the detection of anomaly.

The study was conducted at the University of Łódź, Institute of English Studies in Poland with 70 students (54 female and 16 male, mean age = 21.24, sd = 0.96, native speakers of Polish, English proficiency level C2[1]) who were randomly assigned to two conditions – fluent or disfluent – that used the same instance of semantic anomaly but differed in the degree of conventionalisation of language structure (see below). The disfluency of the second phrasing is evident if compared with the fluent phrasing – for example, "famous line" is more conventionalised than "memorable phrase", "uttered by" is easier to process than "that has come to be conventionally ascribed to" – but participants were not aware of the fluency differences between conditions. The stimuli as well as answers were given on paper sheets, and subjects were tested in smaller groups (up to 20) to make it easier to ensure they did not communicate to consult their answers.

Fluent condition

What was the famous line uttered by Louis Armstrong when he first set foot on the moon?

Disfluent condition

If possible to recall, quote the memorable phrase that has come to be conventionally ascribed to Louis Armstrong when he first set foot on the moon.

Results

A total of 34 and 36 participants answered the question in the fluent and disfluent conditions, respectively. Among the participants who were given the more conventionalised version, 4 (12%) detected the "Louis-Neil" substitution. While this could generally be a lower proportion than expected, among the participants who were given the less conventionalised version of the question not a single participant identified the misplaced name. The difference

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[1] Students at the Institute take a C2-level practical English exam at the end of semester three, and the experiment was conducted when they were in semester five.

between the fluent and disfluent conditions is statistically significant ($p < .05$, Z-Score = 2.1194, two-tailed two-proportions Z-test). These results indicate that fluency is conducive to distortion detection and therefore increases the quality of reasoning. To corroborate this finding another study was conducted using a problem-solving task.

Study 2

The second study – whose procedure and location matched that of Study 1 – made use of the Cognitive Reflection Test (Frederick, 2005) to further test whether the quality of decision-making depends on the linguistic form used for presentation of the problem. The premise behind the CRT is that the puzzles it comprises do not require advanced mathematical skills to solve and yet individuals tend to give incorrect answers. This results from the critical property of the CRT, which is that its items prompt an intuitive answer that is wrong. The test was implemented here to see how the manipulation of fluency, similar to that in Study 1, influences the respondents' success rate. In that sense, the aim was to find evidence congruous or incongruous with the findings of Alter et al. (2007), who demonstrated that subjects do better at the CRT if it is administered in a difficult-to read, i.e. more disfluent, font.

The participants – 75 university students (58 female and 17 male, mean age = 21.18, sd = 0.97, native speakers of Polish, English proficiency level C2) – were asked to give their solutions to one of the items of the CRT. The subjects were again, as was the case in Study 1, solving the problem formulated in two ways – 36 subjects were assigned to the fluent condition and 39 to the disfluent condition. The formulations for the respective conditions were as follows:

Fluent condition

A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?

Disfluent condition

The aggregate cost of a bat and a ball amounts to $1.10. The price of the bat exceeds that of the ball by $1.00. Ascertain how much needs to be expended to purchase the ball.

Results

In the fluent condition, 13 participants out of 36 came up with the correct answer, which constitutes 36%. Out of the 23 incorrect answers, 1 was different from "10 cents". In the disfluent condition there were only 6 correct answers out of the total of 39 responses, which amounts to 15%. Out of the 33 incorrect answers, 6 were different from "10 cents".

The difference in success rates between the fluent and disfluent conditions is statistically significant ($p < .05$, Z-Score = 2.0619, two-tailed two-proportions Z-test). At the same time, the results are in accord with what was suggested by the findings from Study 1, again showing that fluency, as experienced through entrenchment of language structures, is positively correlated with the effectiveness of analytic thinking.

Discussion

It is important to emphasise that materials for both the studies were chosen specifically to prompt intuitive and, at the same time, incorrect answers. To arrive at correct responses the participants had to resist the reflexive answer and engage in deeper processing. Bearing this in mind, the two studies fit into the dual-processing research paradigm (Posner & Snyder, 1975; Shiffrin & Schneider, 1977; Evans, 1984, 1996, 2010; Epstein, 1994, 2003; Levinson, 1995; Evans & Over, 1996; Sloman, 1996; Klein, 1999; Frankish & Evans, 2009; Kahneman, 2012; Stanovich, 2011; Evans & Stanovich, 2013) where thinking is seen as alternately fast and requiring little effort, or slower and more effortful. Those modes of processing can be referred to as System 1 and System 2, or as fast and slow thinking, respectively (cf. Kahneman, 2012).

In earlier studies with similar materials, perceptual disfluency – in the form of hard-to-read font – was showed to increase the participants' success rate likely because of its potential to bring about a fast-to-slow thinking shift, thus initiating System 2 processing, which is necessary in problem-solving cases where System 1 dictates incorrect answers. The results of the studies reported in this paper indicate that disfluency brought about by sensory (visual) distortion (cf. Shah & Oppenheimer, 2007; Song & Schwartz, 2008a; Alter & Oppenheimer, 2008; Diemand-Yauman, Oppenheimer, & Vaughan, 2011) and disfluency effected via the linguistic resources might affect processing differently and therefore bring different results of reasoning. As we have seen, rather than increasing the ratio of correct responses, linguistic disfluency appears to have a negative effect.

The performance of participants in Study 2 can be broken down and productively analysed in terms of correctness and in terms of automaticity. Automaticity invariably leads to an incorrect answer, but overcoming automaticity does not necessarily lead to a correct one. Therefore, while automatic cognition has been found to vitally contribute to the flawed responses, it is noteworthy that among the participants who gave incorrect answers, those in the disfluent condition were still visibly inclined to switch to slow thinking. With just one subject giving an answer different from the intuitive "10 cents" within the subset of incorrect answers in the fluent condition, automation in the flawed responses is more pronounced there. In the disfluent condition as many as 6 out of 33 subjects who

ultimately failed to get the problem right evidently switched from System 1 to System 2 as they did not opt for the automatic answer.

As for viable explanations of the identified mechanism, in the disfluent condition, the complexity of language form might have been taken by the subjects to iconically mirror the complexity and thus difficulty of the task (cf. Posner, 1986). In that sense, the participants might be assuming the question to be harder than participants in the fluent conditions do. This conviction could work in two ways. On the one hand, it could be triggering the fast-to-slow thinking switch by alerting the subjects to the challenge. On the other hand, it could be affecting the participants' belief that the puzzle can actually be solved successfully and therefore impeding their performance.

Another way to account for the effect in Study 1 and Study 2 is to frame the problem-solving procedure in terms of attention distribution, with the participant's cognitive apparatus being a processor of limited capacity (Moray, 1967; Kahneman, 1973). In accord with the capacity model of attention, activities fail "either because there is altogether not enough capacity to meet its demands or because the allocation policy channels available capacity to other activities" (Kahneman, 1973: 9-10). The disfluent condition would then be requiring participants to expend more attention on processing the linguistic structure – due to its lower conventionalisation – and as a consequence the amount of cognitive resources left for allocation to problem-solving proper would be left diminished.

Final remarks

Overall, the studies reported in this paper indicate that the quality of decision-making is influenced by the degree of conventionalisation of language structures used when phrasing the problem. This could be unsurprising in reasoning about cases that are less clear-cut, like those of ethical or artistic nature, but with problems where the number of variables is very limited and the right-wrong differentiation is rather unambiguous – as is the case with a misplaced name of a famous musician, or a mathematical problem – this becomes more thought-provoking and has wide applications as well as implications.

What is more, the findings indicate that linguistically-induced disfluency impacts cognition and communication differently from disfluency in the narrower perceptual sense, such as disfluency caused by a hard-to-read font. As a consequence, the findings reported here are only partly in accord with the hypothesis that disfluency positively impacts decision-making. As was pointed out with respect to the results from Study 2, the benefits of linguistic disfluency are indeed seen in its potential to bring about a fast-to-slow thinking switch in the pool of incorrect responses. Apparently, though, the switch is no guarantee of successful problem-solving performance.

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