Negation in context: Evidence from the visual world paradigm

Isabel Orenes

Universidad de la Laguna, Tenerife, Spain

Linda Moxey

University of Glasgow, Glasgow, UK

Christoph Scheepers

University of Glasgow, Glasgow, UK

Carlos Santamaría

Universidad de la Laguna, Tenerife, Spain

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Please address correspondence to: Isabel Orenes. Universidad de La Laguna. Departamento de Psicología Cognitiva. Campus Guajara, sn. 38205 La Laguna, Tenerife (Spain). Email: iorenes@ull.es. Phone: +34 922 317503.

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Abstract

Literature assumes that negation is more difficult to understand than affirmation, but this might depend on the pragmatic context. The goal of this paper is to show that pragmatic knowledge modulates the unfolding processing of negation due to the previous activation of the negated situation. To test this, we used the visual world paradigm. In this task, we presented affirmative (e.g., *her dad was rich*) and negative sentences (e.g., *her dad was not poor*) while viewing two images of the affirmed and denied entities. The critical sentence in each item was preceded by one of three types of contexts: an inconsistent context (e.g., *She supposed that her dad had little savings*) that activates the negated situation (a poor man), a consistent context (e.g., *She supposed that her dad had enough savings*) that activates the actual situation (a rich man), or a neutral context (e.g., *her dad lived on the other side of town*) that activates neither of the two models previously suggested. The results corroborated our hypothesis. Pragmatics is implicated in the unfolding processing of negation. We found an increase in fixations on the target compared to the baseline for negative sentences at 800 ms in the neutral context, 600 ms in the inconsistent context, and 1450 ms in the consistent context. Thus, when the negated situation has been previously introduced via an inconsistent context, negation is facilitated.

Keywords: negation; context; visual world paradigm.

Introduction

The comprehension of language is context-dependent: its content depends not only on the syntactic and semantic properties of the types of expressions used, but also on facts about the situation in which the expressions are used (Stalnaker, 1998). Negative sentences do not point to the actual situation but to what is not the case. As a consequence, in their comprehension we must figure out what the speaker is referring to, and pragmatics becomes crucial. If someone tells us that their car is not red there should have been a reason to presume (or speculate) that it is red. Otherwise the utterer would have referred to the actual color of the car. In fact, individuals seem to use affirmation to communicate as default, but negation is often used in some specific contexts, and outside of these contexts negation is difficult to understand (Khemlani, Orenes, & Johnson-Laird, 2012).

The representation and processing of negation has important implications for memory and language theories. Research has shown that negative sentences are more difficult to comprehend than their corresponding affirmatives: people take longer to understand negation and are likely to make more mistakes in processing negation (see Carpenter & Just, 1975; Clark & Chase, 1972; Mayo, Schul, & Burnstein, 2004; Trabasso, Rollins, & Shaughnessy, 1971; Wason & Johnson-Laird, 1972; Wason & Jones, 1963). Furthermore, negated concepts are less well recalled than affirmative ones (Fillenbaum, 1966; Lea & Mulligan, 2002; MacDonald & Just, 1989). These results would indicate that negative and affirmative information is processed and represented differently.

Among other explanations, Kaup, Lüdtke & Zwaan (2006) proposed a two-step simulation hypothesis to understand negation. For a negative such as *the door is not open* for example, individuals would first represent the negated situation; an open door; and then the actual situation: a closed door. For an equivalent affirmative (e.g., *the door is closed*), the actual situation is directly available: a closed door (Kaup, Zwaan, & Lüdtke, 2007; Zwaan, Stanfield, & Yaxley, 2002). This two-step processing has been found in metaphors (Hasson & Glucksberg, 2006), quantifiers (Moxey & Sanford (1987), and counterfactuals (Byrne, 2005) among others. Within this framework, it has also been proposed that rather than a two-step sequence of static images, negation would be represented by the continuous-trajectory derivative over time in a perceptual simulation (Anderson, Huette, Matlock, Spivey, 2010; Huette, & Anderson, 2012; Huette, Anderson, Matlock, & Spivey, 2011; Tian, Breheny, & Ferguson, 2010).

Despite this, many studies have also shown that when negation is presented in an adequate context, it can be similar to affirmation (Dale & Duran, 2011; Givon, 1978; Glenberg, Robertson, Jansen & Johnson-Glenberg, 1999; Johnson-Laird & Tridgell, 1972; Nieuwland & Kuperberg, 2008; Strawson, 1952; Wason, 1972). The question that remains unsolved to date is what makes a context 'adequate' for understanding negation. Wason (1965) proposed that negation is easier to understand when it is used to communicate deviations from expectations (see also Givon, 1978). In this case, negation may be easier to understand because the negated situation has been constructed already (Khemlani et al., 2012). For example, Lüdtke & Kaup (2006) presented a context (e.g., *that a boy's T-shirt is dirty after he played outside in the backyard*) that activates the negated situation (e.g., a dirty t-shirt) previously, and the processing of negation (e.g., *the T-shirt was not dirty*) was facilitated. It seems then, that the difficulty of negation is due to the change of attention (or deviation) from the negated concept toward the actual situation. However, when the negated concept is previously activated in an adequate context, its processing is facilitated.

The visual world paradigm allows us to study the unfolding process of comprehending negation. In a typical visual world task verbal and visual inputs are presented simultaneously while the participants' eye movements are recorded. Eye movements provide an index of real time processing that most other methodologies do not offer, and they are sensitive to subtle aspects of language, attention and memory (Allopenna, Magnuson, & Tanenhaus, 1998; Duñabeitia, Avilés, Afonso, Scheepers & Carreiras, 2009; Rayner, 1998). From the literature, it is expected that when something is heard, it is processed and attended to automatically. At the same time, if the object is visible, the eyes begin to move towards the corresponding object (Cooper, 1974; Tanenhaus, Spivey-Knowlton, Eberhard & Sedivy, 1995). It follows that when people are exposed to negative assertions in a visual world paradigm, they will look more frequently at the most active information in working memory.

Our main goal in the present study is to test the role of context in the process of understanding negation. Our hypothesis is that certain contexts can activate the negated concept before the negation is encountered. This is consistent with Khemlani et al. (2012) who, based on Wason (1965), pointed out that negation is easier when the negated situation has been constructed previously within the context. First, we presented affirmative (e.g., *her dad was rich*) and negative sentences (e.g., *her dad was not poor*) in a neutral context (e.g., *her dad lived on the other side of town*), and we expected to find the classical effect of negation: negative sentences takes longer to process than affirmative sentences. This effect could be reduced in a context in which the negated situation has been constructed previously, what we have labeled an inconsistent context (e.g., *She supposed that her dad had little savings*). This context activates the negated situation (e.g., her dad was poor). In a third condition, we presented a consistent context sentence (e.g., *She supposed that her dad had enough savings*) that activates the actual situation (e.g., her dad was rich) followed by the affirmative (e.g., *her dad was rich*) or the negative sentence (e.g., *her dad was not poor*). While the affirmative statement is directly understood after the context sentence, understanding of the negative statement requires listeners to represent a rich man after hearing the context, and then a poor man after hearing negation (not poor), and finally the rich man again. These extra steps required to understand negation will take time compared to affirmation. Therefore, the consistent context is expected to be the most difficult one for negation (see Johnson-Laird & Tridgell, 1972). The extra processing in the consistent context condition should be reflected in the eye movement because people need to change their focus of attention twice from the rich man to the poor man, and from the poor man to the rich man in our example.

Methods

Participants

Fifty native Spanish speakers from the University of La Laguna, Tenerife (Spain), participated in the experiment in exchange for course credits. All of them had normal vision or wore soft contact lenses or glasses.

Materials

Forty-eight experimental vignettes of simple events were heard. The first two sentences in each vignette described a general situation (e.g., *Veronica needed a new car for work. She wondered whether her dad could help her financially*). The second sentence in each vignette presented a context. This sentence was always stated as a presupposition by using reported speech forms (*he supposed, she thought*, etc.) so that there was no a-priori contradiction with the subsequent affirmative or negative sentences. The context could be consistent (e.g., *She supposed that her dad had enough savings*), inconsistent (e.g., *She supposed that her dad had little savings*) or neutral (e.g., *her dad lived on the other side of town*) with respect to the target part of the story in the final sentence that consisted of an affirmative (e.g., *her dad was rich*) or a negative sentence (e.g., *her dad was not poor*).

“(Figure 1 about here)”

For each trial, a different display with two images appeared on the screen. For example, an image of a poor man on the left and a rich man on the right (see Figure 1). The position of each image was counterbalanced across conditions. The order of the materials was randomized, and 12 versions of the full set of materials were prepared: each context (consistent, inconsistent, and neutral) was combined with the two types of sentences (affirmative and negative) and the two poles of the adjective contraries (e.g., poor-rich), so that only one of the 12 possible versions of each experimental item occurred in each presentation file (see Table 1). In total, there were 8 experimental trials in each of six conditions: consistent-affirmative, consistent-negative, inconsistent-affirmative, inconsistent-negative, neutral-affirmative, and neutral-negative. For all trials, the analysis of fixations was time-locked to the onset of the critical adjective in the target sentence, that is, ‘rich’ in an affirmative sentence such as *her dad was rich* and ‘poor’ in a negative sentence such as *her dad was not poor*.

"(Table 1 about here)"

Apparatus and Procedure

Participants' eye movements were recorded at a rate of 500 Hz using an SR Research EyeLink II head-mounted eye-tracker connected to a 21-inch color CRT for visual stimulus presentation. Procedures were implemented in SR Research Experiment Builder. Calibration and validation procedures were carried out at the beginning of the experiment and repeated several times per session. Trials started with the presentation of a central fixation dot for drift correction while participants listened to the general situation and the context (consistent, inconsistent, or neutral). After that, a display with two images appeared for 2 seconds and then the story finished with the presentation of an affirmative or negative sentence that was the target. The trial concluded with the appearance of a written question (e.g. *did Veronica need a new car?)* which participants had to answer by pressing either a "yes" or a "no" button. There was a practice block of four trials before the experiment proper started. The entire experiment lasted approximately 30 minutes.

Results

The eye-movement data generated by the EyeLink system were analyzed as follows. First, bitmap templates were created for identifying regions of interest in each display (e.g., a rich and a poor man). The object regions were defined in terms of rectangles containing the relevant objects; fixations landing within the perimeters of these rectangles were coded as fixations on the relevant objects. The output of the eye-tracker included the x- and y-coordinates of participant fixations, which were converted into region of interest codes using the templates. Fixations shorter than 80 ms (accounting for ca. 0.2% of all fixations) were pooled with preceding or following fixations if they were within 0.5 degrees of visual angle. Times for blinks were added to the immediately preceding fixations. The analyzed time period was from the onset of the target to 3000 ms after the target word (as established on a by-trial basis). This time window was chosen to guarantee there was enough time to comprehend negations (e.g., Kaup, Lüdtke, & Zwaan, 2006; Lüdtke, Friedrich, Filippis & Kaup, 2008). This period was further divided into 50 ms time slots. For each time slot, the number of fixations on the target image was divided by the sum of the fixations on the target and competitor image, yielding fixation probabilities for the target image. Since eye-blinks, off-screen fixations, and empty-space fixations together accounted for no more than 6% of the data at any given point in time, proportions of looks to the competitor image were more or less complementary to proportions of looks to the target image.

"(Figure 2.1 about here)"

Figure 2 depicts probabilities of fixations on the target region of interest as a function of time and context. Figure 2.1 corresponds to the neutral context, where people heard a context that was not related to the critical sentence (or target). For example, '*Her dad lived on the other side of town*'. In this case the context does not favour any of the images that are shown on the screen, therefore listeners initially look at both images equally often. When participants listened to the affirmative sentence, e.g. '*Her dad was rich'* and the negative sentence, e.g. '*Her dad was not poor*', fixation probabilities on the target interpretation image increased (e.g. the rich man), but this increase was earlier for affirmative sentences than for negative sentences.

“(Figure 2.2 about here)”

Figure 2.2 shows the data for the inconsistent context condition, where participants heard the critical affirmative or negative sentence following a context that was inconsistent with what was mentioned in the critical sentence. As can be seen, people started to look at the target interpretation image earlier in the affirmative than in the negative sentence condition.

“(Figure 2.3 about here)”

Figure 2.3 shows the data for the consistent context condition. In this context, affirmative (e.g., *her dad was poor* after *She supposed that her dad had little savings*), and negative sentence (e.g., *Her dad was not poor* after *She supposed that her dad had enough savings*) ultimately led to the same pattern of fixations. The difference is in the timing: participants fixate on the target more quickly following an affirmative compared to a negative statement.

T-test against baseline

To avoid problems inherent to proportional data, participant and item averages were arcsin-transformed prior to t-test comparisons. Given that 180-200 ms are usually assumed to account for saccade programming (Martin, Shao, & Boff, 1993), the mean of the first time-region (0 - 100 ms) was considered to be the *baseline* and was used to conduct statistical comparisons against means on each time point until 3000 ms later (for a similar method, see Huettig & Altmann, 2010). This correction to baseline allowed us to control for any bias in the pattern of fixations on figures caused by the type of context. A False Discovery Rate (FDR) thresholding procedure was used to effectively control for the type 1 error due to multiple comparisons (58 for each condition; Genovese, Lazar, & Nichols, 2002). We eliminated one subject due to problems in the recording of her eye movements.

In the neutral context, there was an increase in fixation on the target interpretation for affirmative sentences at 500 ms (pFDRcorr1=.011(subject analysis); pFDRcorr2=.031(item analysis)) and for negative sentences at 800 ms (pFDRcorr1=.007; pFDRcorr2=.001). In the inconsistent context, the significant differences with respect to the baseline started at 500 ms for affirmative sentences (pFDRcorr1=.016; pFDRcorr2=.002) and at 600 ms for negative sentences (pFDRcorr1=.014; pFDRcorr2=.025). It is important to keep in mind that while affirmative sentences are processed similarly in both contexts, negative sentences are facilitated in the inconsistent context when the negated situation is already constructed. In the consistent context condition, there was an increase in fixation on the target interpretation starting at 650 ms (pFDRcorr1=.002; pFDRcorr2=.006) for affirmative sentences, while there was a decrease in fixation on the target interpretation at the beginning, at the temporal point of 800 ms, (pFDRcorr1=.048; and between 450 and 700 ms in the item analysis: pFDRcorr2=.028) and then there was an increase in fixation starting at 1450-1550 ms (pFDRcorr1=.039; and from 2000 ms in the item analysis pFDRcorr2=.047) for negative sentences. In this last context, we can see that participants needed to build first the negated situation around 800 ms because it has not been constructed previously and then, the actual situation around 1450 ms. In conclusion, pragmatic information clearly has an influence on the process of understanding negations.

The growth-curve analysis

This analysis is a multilevel regression technique designed for analysis of time course with orthogonal power polynomials (see Mirman, Dixon, & Magnuson, 2008). First, we modeled the effect of polarity separately for each verbal context. With this method, we can examine if the differences between affirmative and negative sentences lay at the intercept (which would reflect differences between overall fixation ratios), at the linear term (which would reflect differences at a monotonic change in fixation ratios), and at the quadratic term (which would reflect differences at the symmetric rise and fall rate of fixation ratios around a central inflection point). Second, we modeled whether differences between affirmative and negative sentences varied across contexts. We report a deviance statistic, often called -2LL (minus 2 times the log-likelihood), the changes in deviance (AD), and the p-value. The change in deviance allows us to test whether including the parameter increases the fit of the model (see Table 2).

The results of Table 2 show that affirmative and negative sentences differed significantly across contexts. In the neutral context, there was a significant effect at the intercept, which indicates that fixation on the target interpretation was higher for affirmative sentences than for negative sentences. There was also a difference at the linear term (slope), reflecting a different increase in fixation for affirmative and negative sentences. That is, while affirmative sentences increased at 500 ms, negative sentences increased at 800 ms. The inconsistent context had significant effects on the linear and the quadratic terms. These effects reflect that affirmative sentences had a steeper slope, while affirmative sentences increased at 500 ms, negative sentences increased at 600 ms. The largest effect was on the quadratic term. That is, the difference between affirmative and negative sentences was primarily in the rise and fall of the fixation probability curves. Figure 2.2. shows that the temporal location of the peak is around 1000 ms for affirmative sentences and 1500 ms for negative sentences. In the consistent context, we only found differences between affirmative and negative sentences in the quadratic term. This result reflects differences in the rise and fall of fixation proportions between affirmative and negative sentences. Figure 2.3. shows that participants decreased their attention on the target around 400 ms (the peak) and then, they increased their attention, with the temporal location of the peak around 700ms for affirmative sentences. However, the proportions are different for negative sentences, where the lowest peak was around 700 ms and the highest peak was around 2500 ms. On the other hand, the differences between affirmative and negative sentences varied across contexts in the quadratic term. This indicates that the main difference between contexts is in the distribution proportion rather than the intercept or slope. To sum up, these results indicate that affirmative and negative sentences result in different target fixation profiles across all contexts.

“(Table 2 about here)”

Discussion

The results are consistent with the view that pragmatic knowledge influences the process of understanding negation. We found an increase in fixation compared to the baseline on the target for negative sentences at 800 ms in the neutral context condition, 600 ms in the inconsistent context condition, and 1450 ms in the consistent context condition. These differences are smaller for affirmative sentences, at around 500 ms in the neutral and inconsistent context condition, and at around 650 ms in the consistent context condition. Therefore, it seems that pragmatic information, as manipulated in this experiment, modulates the unfolding processing of negation more than of affirmation.

On the other hand, our results show that negative sentences are always slower to process than affirmation regardless of context. This finding is at odds with many studies that indicate that negation and affirmation can be processed in a similar way (Dale & Duran, 2011; Givon, 1978; Glenberg et al., 1999; Johnson-Laird & Tridgell, 1972; Nieuwland & Kuperberg, 2008; Strawson, 1952; Wason, 1972). That is, while our results have shown that pragmatic information can indeed aid the processing of negation, the latter still remained more difficult to process than affirmation regardless of context. This could suggest that, compared to other methods, visual world eye-tracking data may be more sensitive to subtle, context-independent processing differences between affirmative and negative sentences.

In the neutral context, we found the classical effect of negation (see Carpenter & Just, 1975; Clark & Chase, 1972; Mayo et al., 2004; Trabasso et al., 1971; Wason & Johnson-Laird, 1972; Wason & Jones, 1963). Growth-curve analysis revealed an effect at the intercept, indicating that fixations on the target were more likely (within the considered time period) for affirmative sentences than for negative sentences. More importantly, there was also a difference in the linear term, reflecting differential increases in target fixation probability over time for affirmative (at ca. 500 ms) and negative sentences (at ca. 800 ms). That is, participants were mainly slower to attend to the target in negative than in affirmative sentences (see also: Orenes, Beltrán, & Santamaría, 2014). This finding could be related to the fact that negated concepts are less readily recalled than affirmative ones (Fillenbaum, 1966; Lea & Mulligan, 2002; MacDonald & Just, 1989).

In the consistent context, participants heard the negative sentence *Her dad was not poor* after hearing *She supposed that her dad had enough savings*. In this case, participants switched their attention from the image of the rich man (after hearing the context) toward the image of the poor man (after hearing negation) 800 ms after hearing the critical word ('poor'). After that, they switched their visual attention again from the poor man towards the rich man (at around 1450 ms). These two computations take extra time (see also Johnson-Laird & Tridgell, 1972). It is interesting to note that a comparable increase in the number of fixations on the target started at around 650 ms from critical word-onset in affirmative sentences. This delay in comparison to the other context conditions may be due to the target not being very informative, that is, it confirms information already suggested by the context. As the theory of relevance purports, communication must be relevant (Grice 1961; Wilson & Sperber, 2004); however, in the consistent context condition, after listening to for example, *She supposed that her dad had little savings*, listeners already inferred that her dad must have been poor, thus when they actually heard the affirmative *Her dad was poor*, this information was less relevant in the sense that participants already knew it. As a result, (re-)inspecting the target was somewhat delayed.

The process of understanding negation is facilitated when the negated situation has been presented previously (Givon, 1978; Khemlani et al., 2012; Lüdtke & Kaup, 2006; Wason, 1965), but it is still more difficult than understanding affirmation. This suggests that the differences between negative and affirmative sentences are not purely pragmatic. In the inconsistent context, in which the negated situation was presented previously, we found differences in the linear term, reflecting a different increase in fixation for affirmative (at around 500 ms) and negative sentences (at around 600 ms). There was also a difference in the quadratic term, reflecting differences at rise and fall in fixation proportions between affirmative and negative sentences. That is, the highest peak happened around 1000 ms for affirmative sentences ms and around 1500 ms for negative sentences.

The advantage of using the visual world paradigm is that this method allows us to see how people update their current interpretations online while processing negation within different contexts. For example, when participants were focused on the poor man image after hearing the inconsistent context, and then they heard: *he was not poor*, they switched toward the target image (the rich man) at 600 ms. However, as they were focused on both images equally often in the neutral context, when they heard: *he was not poor*, they switched toward the rich man target image with a delay compared to the inconsistent context, at 800 ms. The visual world paradigm was therefore sensitive enough to detect the effect of pragmatic.

It is interesting to note that affirmative and negative sentences were easier when they were used to deny a false belief (inconsistent context) than when no prior beliefs were established (neutral context) because previous literature suggests that once beliefs are held, they should be difficult to change. That is, people tend to maintain their beliefs even when faced with evidence to the contrary (Khemlani & Johnson-Laird, 2012; Orenes, Navarrete, Beltrán & Santamaría, 2012). Based on this premise, one could predict that when people listen to a context that is inconsistent with the target, the latter must be processed more slowly (see Ferguson, Sanford, & Leuthold, 2008). However, our results show that both affirmative and negative sentences are processed more quickly in the inconsistent context (when they are used to deny or change a belief) than in a neutral context. This could probably be due to a priming effect. In our experiment, we presented a context that led to a prediction, for example whether the critical protagonist (‘her dad’) was rich or poor. Given the context *She supposed that her dad* *had little savings*, for example, there is a prediction that 'her dad' is poor. In the inconsistent condition, this was then rejected with 'her dad was not poor'. The neutral context *Her dad lived on the other side of town* makes no such prediction about the critical protagonist's financial status. As Khemlani and collaborators (2012) pointed out, individuals should find it easier to understand a negation if they have already constructed the models of the corresponding affirmative assertion.

In conclusion, pragmatic information influences the processing of negation more than affirmation, especially when the negated situation is already constructed, but it does not explain all of the difference in difficulty between negative and affirmative sentences. Negation is, clearly, a complex phenomenon and further research should be conducted to its apprehension.

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Figure Captions

Figure 1. Example of a display with two images, one corresponds to a poor man and another to a rich man.

Figure 2.1 Probabilities of fixations on the target interpretation image (the rich man) over time, separately for affirmative and negative sentences within *neutral contexts*. Before the onset of the target word ($t < 0$), participants focused on both images about equally frequently because the context was neutral. From about 500 ms after target word onset, probabilities of fixations on the target interpretation image started to increase for affirmative and negative sentences. Error bars represent 95% confidence intervals within subjects such that no overlap between conditions indicates a significant difference (see Morey, 2008; O´Brien & Cousineau, 2014).

Figure 2.2 Probabilities of fixations on the target interpretation image (the rich man) over time, separately for affirmative and negative sentences within *inconsistent contexts*. In this context, we observed that participants changed from initially preferring the poor man (considerably less than 50% of fixations on the target interpretation image early on) to the rich man after hearing the critical word. As the two curves indicate, this happened earlier in affirmative than in negative sentences. Error bars represent 95% confidence intervals within subjects such that no overlap between conditions indicates a significant difference (see Morey, 2008; O´Brien & Cousineau, 2014).

Figure 2.3 Probabilities of fixations on the target interpretation image (the rich man) over time, separately for affirmative and negative sentences within *consistent contexts*.

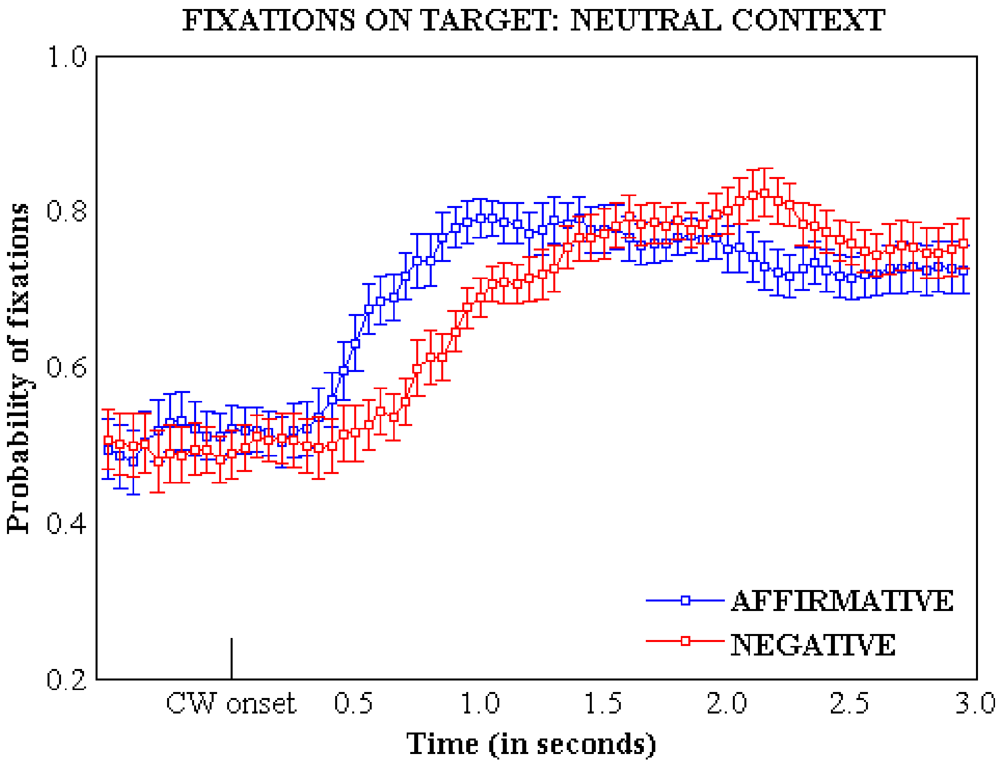
In this context, we observed that participants were already biased towards the target interpretation image early on (around 70% of fixations were on the target interpretation image before the critical word was heard). In both conditions, proportions of looks to the target first dropped to around 60%, and then rose towards an asymptote of around 80% after processing the critical word. This rise towards asymptote happened much earlier in the affirmative than in the negative sentence condition. Error bars represent 95% confidence intervals within subjects such that no overlap between conditions indicates a significant difference (see Morey, 2008; O´Brien & Cousineau, 2014).

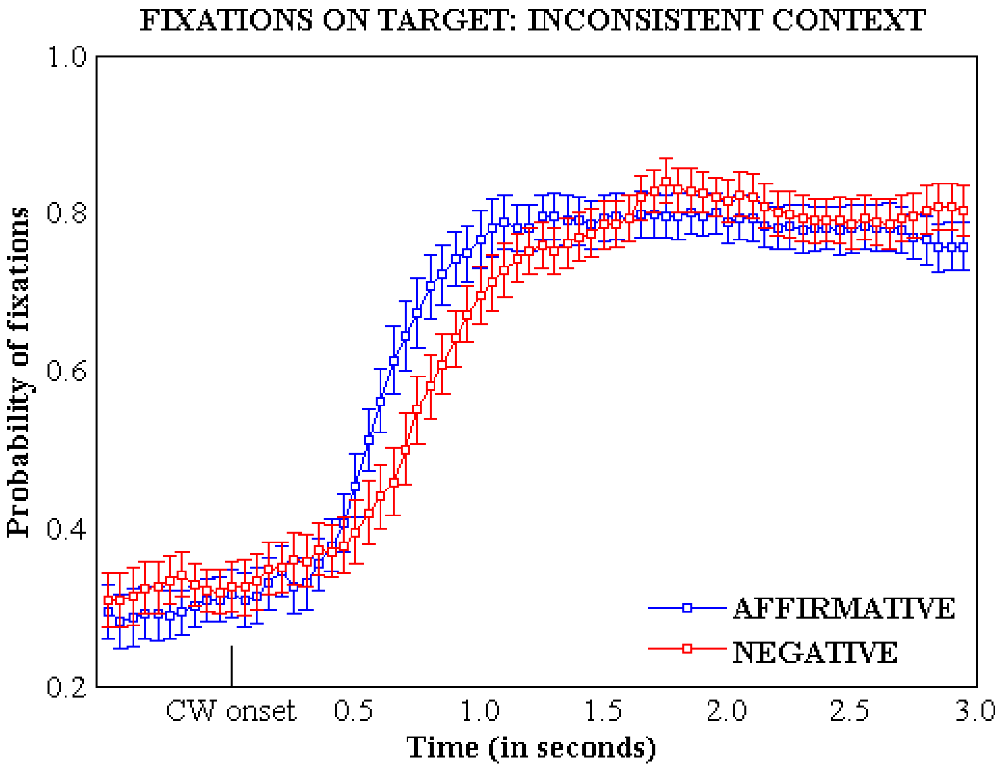
Table 1. Examples of experimental sentences

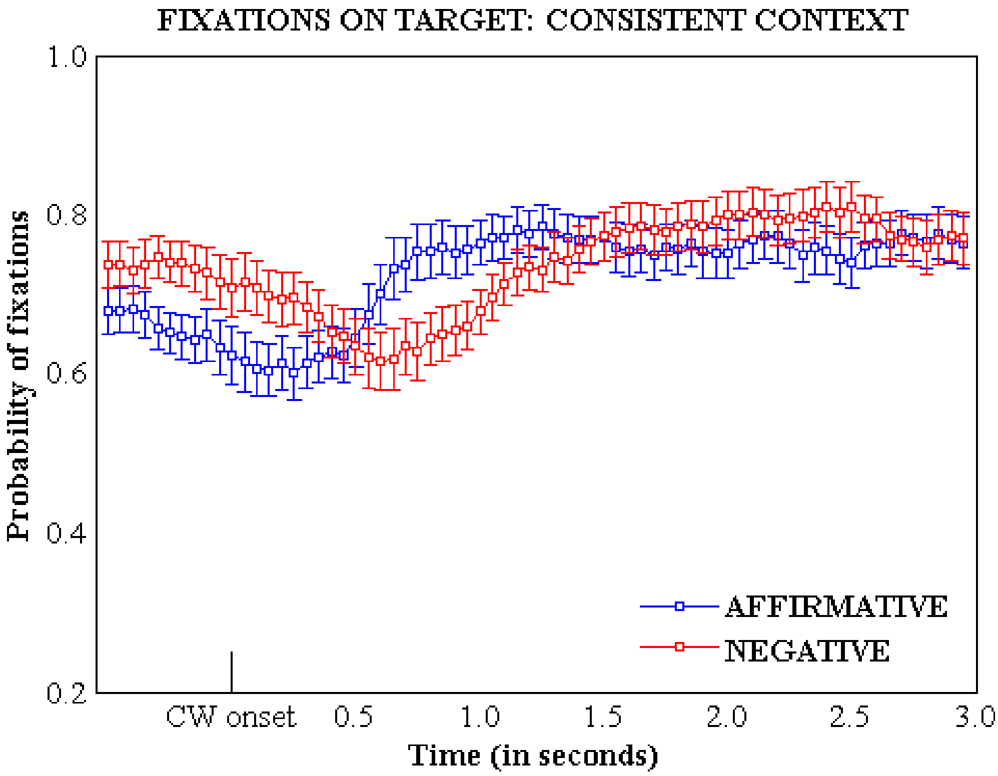
Veronica needed a new car for work. She wondered whether her dad could help her financially.	
Consistent-Affirmative:	She supposed that her dad had little savings. Her dad was poor. *Version 1.*
	She supposed that her dad had enough savings. Her dad was rich. *Version 2.*
Consistent-Negative:	She supposed that her dad had enough savings. Her dad was not poor. *Version 3.*
	She supposed that her dad had little savings. Her dad was not rich. *Version 4.*
Inconsistent-Affirmative:	She supposed that her dad had enough savings. Her dad was poor. *Version 5.*
	She supposed that her dad had little savings. Her dad was rich. *Version 6.*
Inconsistent-Negative:	She supposed that her dad had little savings. Her dad was not poor. *Version 7.*
	She supposed that her dad had enough savings. Her dad was not rich. *Version 8.*
Neutral-Affirmative:	Her dad lived on the other side of town. Her dad was poor. *Version 9.*
	Her dad lived on the other side of town. Her dad was rich. *Version 10.*
Neutral-Negative:	Her dad lived on the other side of town. Her dad was not poor. *Version 11.*
	Her dad lived on the other side of town. Her dad was not rich. *Version 12.*

Table 2. GCA results of the comparisons between affirmative and negative conditions within each context and of the comparison of the polarity effect (affirmative minus negative) across contexts.

Model	-2LL	AD	*p*
Neutral Context			
Base	69,898.61		
Intercept	69,894.01	4.60	.032
Linear	69,865.69	28.32	<.001
Quadratic	69,862.95	2.74	.097
Inconsistent Context			
Base	70,355.92		
Intercept	70,355.04	0.88	.348
Linear	70,345.93	9.11	.002
Quadratic	70,327.16	18.77	<.001
Consistent Context			
Base	69,622.72		
Intercept	69,622,72	0	.947
Linear	69,620.60	2.12	.146
Quadratic	69,575.04	45.56	<.001
Contexts			
Base	110,835.6		
Intercept	110,835	0.6	.74
Linear	110,829	6.00	.0505
Quadratic	110,816.9	12.1	.002


FIXATIONS ON TARGET: NEUTRAL CONTEXT
1.0
0.8
0.6
0.4
0.2
Probability of fixations
AFFIRMATIVE
NEGATIVE
CW onset
0.5
1.0
1.5
2.0
2.5
3.0
Time (in seconds)


FIXATIONS ON TARGET: INCONSISTENT CONTEXT
1.0
0.8
0.6
0.4
0.2
Probability of fixations
CW onset
0.5
1.0
1.5
2.0
2.5
3.0
Time (in seconds)
AFFIRMATIVE
NEGATIVE



FIXATIONS ON TARGET: CONSISTENT CONTEXT
1.0
0.8
0.6
0.4
0.2
Probability of fixations
AFFIRMATIVE
NEGATIVE
CW onset
0.5
1.0
1.5
2.0
2.5
3.0
Time (in seconds)