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A Linguistic or Pictorial Context: Does It Make a Difference?

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ABSTRACT

In two experiments this study tested the *Graded Salience Hypothesis* and the *Defaultness Hypothesis*. It weighs the effects of linguistic versus pictorial contexts in terms of activation (or suppression) of default, salient meanings when context invites nondefault, less-salient alternatives. Using a naming task, Experiments 1 and 2 looked into the processing speed of ambiguous probe words, following a linguistic or pictorial prime, supportive of the less-salient, nondefault meaning. Prime presentation was either limited to 350 ms (Experiment 1) or self-paced (Experiment 2). Findings support the *Graded Salience Hypothesis* and the *Defaultness Hypothesis*, showing that, as predicted, default meanings were activated initially even when context, whether linguistic or pictorial, was strongly biased toward the alternative, nondefault meaning. These novel findings suggest that linguistic and pictorial contexts affect linguistic disambiguation to the same extent.

Introduction

This study tests the *Graded Salience Hypothesis* (Giora, 1999, 2003) and the *Defaultness Hypothesis*[1] (Giora, Givoni, & Fein, 2015) with regard to whether the processing of an ambiguous word in a pictorial context is similar to its processing in a linguistic context. For some decades psycholinguistic research has studied the effects of context on language processing—how and when information, gleaned from the context, affects processing of linguistic stimuli. According to the received view, context affects the processing and understanding of words, especially in the case of ambiguities, when disambiguation is required. However, there is an ongoing debate as to the stage (whether initial or late) at which context effects come into play. Are individual meanings filtered out early on during processing if they are irrelevant to the context, and therefore not activated at all, or, conversely, are all meanings exhaustively activated? If so, are they activated simultaneously, or is there some ordering of activation? For example, the Hebrew word עגלה can be read either as /agala/(*trolley*; which is the salient meaning[2]) or as /egla/ (female *calf*; which is the less-salient meaning). The question we explore here relates to whether, given a context of a cow, only the appropriate, nondefault, less-salient /egla/ meaning will be activated or whether both /egla/ and /agala/ will be simultaneously activated, the relevant meaning selected only at a later processing stage. Alternatively, will the default, more salient meaning be activated initially, despite its lack of relevance to the context?

According to the *Direct Access View* and the *Interactionist View* (e.g., Martin, Vu, Kellas, & Metcalf, 1999; Vu, Kellas, Metcalf, & Herman, 2000; Vu, Kellas, & Paul, 1998), the context has a significant effect, starting early on from the very initial stages of comprehension. This approach assumes a single mechanism that is sensitive to both linguistic and nonlinguistic knowledge. It maintains that during processing there is an early interaction between linguistic and contextual information, so that both are activated simultaneously, with context having effects on ambiguity resolution from very early on, especially when the context is highly supportive. In this case,

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irrelevant meanings are inhibited, and their level of meaning activation never reaches a threshold (Vu et al., 1998). Given that the selection of the appropriate meaning is context-dependent, the result is a contextually appropriate response. For example, given the context of a cow, the letter string עגלה will only activate the appropriate meaning of /egla/ (*calf*). The /agala/ (*trolley*) meaning, which is contextually irrelevant (even if more familiar and salient), will be barred and will not reach a threshold.

In contrast, the *Modular View* (Fodor, 1983) proposes two distinct processing mechanisms: a central integrative top-down mechanism, sensitive to contextual information and a modular mechanism, involving distinct expert systems, whose bottom-up processes activate all available meanings automatically and simultaneously, regardless of context. Once this output is made available to the central mechanism, the contextually appropriate meaning is selected, whereas the rest are being discarded as irrelevant (Connine, Blasko, & Wang, 1994; Onifer & Swinney, 1981; Swinney, 1979; Till, Mross, & Kintsch, 1988). For example, when the letter string עגלה is embedded in the context of a cow, it will initially activate both meanings of the word (/agala/and/egla/). Later on, the central mechanism, which is sensitive to contextual information, will select the relevant meaning (/egla/, *calf*) and suppress the irrelevant one (/agala/, *trolley*). As opposed to the Interactionist and Direct Access views, this view assumes that the effect of context is not immediate; rather, it affects processing at a later stage, following the exhaustive automatic activation of all the stimulus' meanings. Additionally, and contra the Direct Access View, it does not predict immediate inhibition of inappropriate but default meanings.

The *Reordered Access Model* proposes an intermediate model, according to which the linguistic mechanism is sensitive to context but involves a single mechanism (Binder & Rayner, 1998, 1999; Duffy, Morris, & Rayner, 1988; Frazier & Rayner, 1990; Rayner, Pacht, & Duffy, 1994). Accordingly, context can affect lexical processing and activate the appropriate meaning initially. Still, unlike the Direct Access View, this mechanism does not inhibit the activation of irrelevant meanings. This single mechanism is therefore affected by both the strength of contextual support and the degree of meaning salience. Findings show that even when context strongly supports the nondefault, less-salient meaning, the default, salient meaning will still be activated alongside the contextually compatible, less-salient alternative (Giora, 1997, 2003). For example, in the context of a cow, both meanings (/agala/, *trolley* and /egla/, *calf*) will be activated, without the former being inhibited on account of its contextually incompatibility. However, unlike the Direct Access View, according to which the context inhibits the inappropriate meaning, the Reordered Access View predicts no automatic inhibition of salient meanings, even when the context supports the less-salient alternative. Despite these differences, these two theories propose a single mechanism, sensitive both to lexical and contextual information.

Following the Fodorian model, and contrary to the interactive models, the *Graded Salience Hypothesis* (Giora, 1997, 1999, 2003) and the *Defaultness Hypothesis* (Giora et al., 2015) predict the speed superiority of defaultness, regardless of context. Similar to Fodor's Modular View, here too, two distinct mechanisms are assumed; one is an automatic, bottom-up, modular mechanism, sensitive only to linguistic information, and another, which is a top-down, central mechanism, is sensitive to both the output of the linguistic stimulus and that of the context. The central mechanism can utilize the output of the modular systems and even predict the oncoming appropriate meaning, but it cannot block meanings activated during bottom up processes; hence, salient meanings cannot be inhibited (by any kind of context), not even when inappropriate. All meanings are therefore activated automatically upon encounter of the linguistic stimulus, regardless of context (Giora, 1997, 1999, 2003; Peleg & Eviatar, 2008; Peleg, Giora, & Fein, 2001). However, as opposed to the Fodorian model, the activation of the various meanings is governed by their degree of salience/defaultness, resulting in a serial access. Initially, a default, salient meaning will be accessed, following which a nondefault, less-salient meaning will be activated. For example, given the context of a cow, the word עגלה will first activate the salient meaning /agala/; later on, it will activate the related /egla/ meaning.

Note, further, that according to the *Graded Salience* and *Defaultness Hypotheses*, suppression of contextually inappropriate meanings or interpretations is not automatic. Salient, yet contextually inappropriate meanings that do not interfere with the interpretation process (such as the literal meaning or interpretation of metaphors and ironies) are not suppressed. Instead, they are retained, since they contribute to the interpretation process (on a functional approach to suppression; see Giora, 2003; Giora, Fein, Aschkenazi, & Alkabets-Zlozover, 2007). The processes of either retaining or suppressing the contextually inappropriate meanings depend on discoursal aims. If context invites retention of the inappropriate activated meanings, which are amenable to ambiguity, as in literary or artistic contexts (see Giora et al., 2017; Heruti, 2015), these responses remain active. Similarly, in the processing of nondefault (affirmative) ironies and metaphors, the latter relying on the default literal but contextually inappropriate meanings or interpretations for their derivation, these responses also remain active (see Fein, Yeari, & Giora, 2015; Giora, 1999, 2003; Giora et al., 2007, 2015, 2013; Peleg & Eviatar, 2008; Peleg et al., 2001). However, meanings that interfere with the interpretation process will be discarded (see Giora et al., 2007). So far the discussion has revolved around the question related to contextual effects on processing of linguistic targets/probes. The next question is whether processing linguistic items in a visual context will affect similar outputs.

Will pictorial and linguistic contexts have the same effects on interpretation processes?

An examination of the effect of a pictorial context on the processing of linguistic information raises a question as to the interaction between the linguistic and visual systems. Current literature on the interaction between pictures and written words has mostly used the Cross-Modal Semantic Priming task.[3] Priming effects suggest a semantic relation between the prime and the probe (Glaser, 1992; Neely, 1991). Cross-modal priming has been used to examine and compare the two types of priming and their similarity (Bajo, 1988; Bajo & Cañas, 1989; Carr, McCauley, Sperber, & Parmelee, 1982; Kircher, Sass, Sachs, & Krach, 2009; Sperber, McCauley, Ragain, & Weil, 1979; Vanderwart, 1984). Studies have also looked at the differences between the two directions of priming between different modalities (picture-word/word-picture) as well as the priming within a modality, with either semantic (Sperber et al., 1979), phonological, or orthographic relatedness (Bajo, 1988; Carr et al., 1982), to better understand the relation between the pictorial and linguistic systems (see Heruti, 2015 for a review).

Paradigms that probe the interaction between word and picture demonstrate differences between naming a word and naming an image. As early as Cattel (1886), it has been noted that there is a difference between the processing of words and pictures, with claims that even if pictures were processed faster (e.g., color, which is processed faster than a letter), the naming of a picture is slower. Fraisse (1969) claimed that training does not improve naming speed for pictures and proposed that the difference between word and image stems from the fact that multiple words can be matched to a picture, whereas a word has only a single lexical referent (it should be noted that this study did not use ambiguous words).

Similar results showed faster and more automatic naming of words than of pictures (Carr et al., 1982; Glaser, 1992; Huttenlocher & Kubicek, 1983). For instance, Carr and colleagues (1982) showed that as compared with words, pictures provide faster access to their meaning than to their naming; semantic priming of probe words was faster with pictorial than with lexical primes, whereas picture primes showed greater priming effects than lexical primes when the probe was a picture (due to the joint modality). Picture naming took longer to process and was taken to be a less automatic process, due to slower naming times for pictures than for words. Since this study deals with the comparison between linguistic and pictorial processing, the naming of pictures versus words is necessary to discuss. In this study we focus on the comparison between the processing of the linguistic and pictorial contexts in relation to ambiguous words.

An fMRI study by Kircher and colleagues (Kircher et al., 2009) looked at cross-modal semantic priming, focusing on the effect of context, to test whether the representations are joint or distinct, while looking at the difference between cross-modal (picture-word) and unimodal (word-word)

priming. Similar brain activation effects were found in both conditions, suggesting that the two types of processing share a common neural substrate in the bilateral frontotemporal cortex, concluding, similarly to the Amodal System approach, that the semantic processing system is not dependent on modality (Caramazza, Argye, Brenda, & Romani, 1990; Vandenberghe, Price, Wise, Josephs, & Frackowiak, 1996).

However, weighing linguistic against pictorial contexts and their effect on priming linguistic probes has not been tested yet. Therefore, the aim of our experiments is to investigate the effect of a supportive context, whether lexical or pictorial, on the processing of nondefault, less-salient meanings of ambiguous words. Similarly to Kircher and colleagues, the current study looks at semantic priming of both cross-modal and unimodal trials, with either word-word or picture-word dyads. However, whereas Kircher and colleagues used a lexical decision task on unambiguous words, here we use naming of ambiguous words. Moreover, the current study tests the effects of the interstimulus interval between the prime, be it a word or a picture, and the ambiguous probe word to differentiate early and late stages of processing ambiguous words.

The priming studies reviewed above point to an interaction between the two modalities and to the existence of distinct or shared semantic systems. However, they did not look at the effect of context on picture-word interactions in the processing of ambiguous stimuli, whose ambiguity must be "resolved," given biasing prior context. Tracking this process allows us to better understand the role of context in meaning selection or, conversely, in preserving the ambiguity. Most importantly, it further allows us to find out whether pictorial and linguistic contexts have a similar effect on lexical access, as predicted by the Graded Salience and the Defaultness Hypotheses.

Following the Graded Salience Hypothesis, the current study proposes a layered process, whereby the two mechanisms work in parallel so that context is effective but will not inhibit the automatic activation of the contextually incompatible salient meaning, the latter is activated immediately on account of its saliency, irrespective of contextual information. This raises the question as to whether a pictorial context will affect lexical access in the same manner as a linguistic context. If this is indeed the case, the default, salient meaning of an ambiguous word will be activated automatically, due to its salience/defaultness. Only at a later stage will the pictorial context come into play, as is the case of linguistic contexts (Giora, 1997, 2003; Peleg & Eviatar, 2008; Peleg et al., 2001). Based on the Graded Salience and the Defaultness Hypotheses, we predict that whereas context can facilitate activation of a less-salient meaning of an ambiguous word, it will not inhibit the activation of the alternative salient meaning, even if incompatible. This allows an examination of the interaction between the two meanings (relevant also to poetic or humorous language and the arts).

Thus, if we can show that at short exposure durations the default, salient meaning is activated even when the context (whether linguistic or pictorial) is strongly biased in favor of the less-salient, nondefault meaning, this will support the Graded Salience Hypothesis and the Defaultness Hypothesis.[4] As mentioned earlier, according to these hypotheses, the salient/default meaning will be automatically activated and will not be blocked regardless of contextual information to the contrary. However, activated salient but contextually incompatible meanings can be later suppressed (if interfering with the interpretation process). Additionally, should similar effects on the processing of ambiguity be found for both the pictorial and linguistic contexts, this would allow us to conclude that these two mechanisms are similar in the way they affect language processing.

Experiment 1

Given the prediction, following from the Graded Salience and Defaultness Hypotheses, Experiment 1 tests the expected similar effects shared by the 2 modalities on the processing of linguistic ambiguity. Experiment 1 was therefore designed to measure processing speed of probes in related and unrelated-context conditions, weighing the effects of pictorial against linguistic primes on the processing of linguistic ambiguity.

To track the sequential ordering of probe-meaning facilitation, both types of primes (linguistic and pictorial) were displayed for 350 ms, as in Kircher et al. (2009). Following the prime presentation, participants were asked to name the ambiguous probe (e.g., עגלה, pronounced either as /agala/, *trolley*, or as /egla/, female *calf*). The pronunciation reflects the meaning chosen by the participant. Response times (RTs) of voice onset were recorded to test the production speed of salient and less-salient responses. RTs in each condition can reveal the effect of related and unrelated, linguistic and pictorial contexts on ambiguity resolution and on the degree of accessibility of the various probe meanings.

Recall that according to the Graded Salience and Defaultness Hypotheses, linguistic and non-linguistic contexts will affect probe processing to the same extent. In both cases the salient meaning is immediately activated as an automatic response to the stimulus, regardless of context modality; although context can facilitate activation of a less-salient meaning, it cannot inhibit the activation of the salient but inappropriate meaning. The less-salient meaning can also be predicted by the context, especially if the target word appears at the end of a sentence (see Peleg et al., 2001). Experiment 1 therefore tested the following three questions:

(1) Will context have an immediate facilitative effect on the contextually compatible yet nondefault, less-salient meaning, or will it lag behind the salient albeit contextually incompatible meaning, as predicted by the Graded Salience Hypothesis and the Defaultness Hypothesis?
(2) Will context inhibit the contextually incompatible but default/salient meaning so that it does not reach a threshold, or will that meaning be activated initially on account of its saliency, as predicted by the Graded Salience Hypothesis and the Defaultness Hypothesis?
(3) Will the two prime types (linguistic vs. pictorial) differ in terms of their facilitative effects on the various salient and less-salient meanings, or will they affect processing in the same manner, as predicted by the Graded Salience Hypothesis and the Defaultness Hypothesis?

To that aim, Experiment 1 used a semantically primed naming task. Participants were asked to read aloud an ambiguous probe word presented following a linguistic or a pictorial prime. Probes were either related to the less-salient meaning or were completely unrelated.

Methods

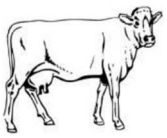
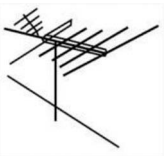
Participants

Twenty-four right-handed, native speakers of Hebrew (17 women) students of Tel Aviv University, mean age 25.63 (SD = 2.19), participated in the experiment in exchange for payment (35 NIS). By self-report, none of them was diagnosed with reading or visual disabilities.

Design and materials

A 2 × 2 factorial design was used, with prime type (linguistic/pictorial) and probe relatedness (related/unrelated) as within-participant factors. Seventy-six ambiguous probe words were selected, each with two homographic and heterophonic readings. Each probe was paired with a semantically related or unrelated prime, based on a series of pretests (see full description below; see also Table 1 for an example).[5] To neutralize effects from the type of semantic relatedness (categorical or schematic; Glaser, 1992; Jones & Golonka, 2012), half of the probes had a prime schematically related to the less-salient meaning (e.g., the prime סוס, *horse*, with the probe בוקר, less-salient reading /bokér/, *cowboy*, salient reading/bóker/, *morning*) and the other half had a prime categorically related to the less salient meaning (e.g., the prime פרה, *cow*, with the aforementioned probe עגלה, less-salient reading /egla/, female *calf*, salient reading /agala/, *trolley*).

Table 1. Examples of the Two Prime Types (Linguistic/Pictorial) and Prime Relatedness (Related/Unrelated).

	Prime Type	Prime	Probe
Related prime	Linguistic	פרה *(cow)*	עגלה Salient meaning: /agala/ *trolley* Less-salient meaning: /egla/ *calf* (female)
	Pictorial		
Unrelated prime	Linguistic	אנטנה *(antenna)*	
	Pictorial		

Five pretests were run to select the experimental materials. Undergraduate students of Tel Aviv University and Beit Berl College participated in the pretests. They were all right-handed, native speakers of Hebrew, and by self-report, none was diagnosed with a reading or visual disability.

Pretest 1: establishing the salient and less-salient meanings of the probe-words. To establish which meaning of the ambiguous probes was salient and which was less salient, 30 participants (20 women) were asked to name ambiguous words as fast and as accurately as possible. Ambiguous words were all homographic and heterophonic, presented without diacritic vowel marks. Seventy-six words were selected, those that had salient meanings that were significantly more likely to be pronounced (M = .89, SD = .10) than the less-salient counterparts (M = .10, SD = .09), $t(75) = 36.5$, $p < .001$. Based on this pretest the probes were split into 4 groups, which did not differ significantly on the frequency of the salient meanings, the frequency of the less-salient meanings, or the average number of syllables, p's >.34. The probe words were split into these four groups so as to later allow counterbalancing of prime type (word/picture) and prime relatedness (related/unrelated) across the four groups.

Pretest 2: assessing the familiarity of the less-salient meanings of the probes. To ensure participants did not fail to name the less-salient meaning of the probes simply due to lack of familiarity with that meaning, the familiarity of the less-salient meanings was tested. Thirty participants (20 women) were asked to rate the familiarity of each probe word. To ensure that the less-salient meaning was rated, all words were presented with diacritic vowel marks, which guarantee an entirely unambiguous meaning. Participants were instructed to mark the familiarity of each word on a seven-point scale (where 1 was unknown and 7 was very familiar). The probe words were rated as highly familiar (M = 6.45, SD = .58). Additionally, this allowed testing the familiarity of the 4 probe groups, which did not differ in their degree of familiarity, $F < 1$.

Pretest 3: assessing ease of recognition and familiarity of the pictorial primes. The aim of pretest 3 was to ascertain that the pictorial prime would easily prime the probe. Thirty participants (20 women) were shown black and white drawings and were asked to name the pictures and rate their degree of familiarity. If they did not recognize the drawing, they were instructed to write "unknown." If they succeeded in naming the picture, they were instructed to rate its familiarity on a seven-point scale (where 1 was unfamiliar and 7 was highly familiar). Most drawings were named correctly (M = .96, SD = .06), with all drawings properly named by at least 73% of the participants. The familiarity rates showed a high level of familiarity (M = 6.56, SD = .06), with all drawings scoring at least 5.31. Additionally, no significant differences (in terms of naming and familiarity) were found between the four groups of pictorial primes (paired with the four groups of probes), Fs < 1.

Pretest 4: assessing prime-words familiarity. The aim of this pretest was to ensure that the linguistic primes, like the pictorial primes, were all familiar to the participants. Thirty participants (20 women) were asked to rate the familiarity of the prime word stimuli on a scale of 1, unfamiliar, to 7, highly familiar. All words received a high rating (M = 6.91, SD = .15), scoring above 6.6 on a seven-point scale. Additionally, no differences were found between the four groups of primes (that were paired with the four groups of probes), F < 1.

Pretest 5: comparing degree of prime-probe relatedness for word and pictorial primes. In addition to pretests 1 to 4, which controlled probes' and primes' familiarity and nameability, pretest 5 was conducted aiming to ascertain that the degree of relatedness of probes to both linguistic and pictorial primes was similar. Comparing the results of pretest 3 (looking into the familiarity of the pictorial primes) with those of pretest 4 (looking into the familiarity of the linguistic primes) shows they both are highly familiar. Still, linguistic primes (M = 6.91, SD = .37) scored significantly higher than pictorial primes (M = 6.56, SD = .37), $t(75)$ = 8.50, p < .001. Indeed, previous studies showed that both naming and rating familiarity is a less ambiguous task for linguistic than for pictorial stimuli (e.g., Carr et al., 1982; Fraisse, 1969; Glaser, 1992; Huttenlocher & Kubicek, 1983). However, the differences in familiarity between linguistic and pictorial primes can be safely ignored if pretest 5 results in no difference in the strength of prime-probe relatedness across the two conditions, as it is the level of relatedness to the prime that is the critical dimension for this study and should be the main factor behind the priming effects in the different conditions.

Accordingly, in pretest 5 each probe word was paired with both a related and unrelated linguistic and pictorial prime. The related primes all acted as an unrelated prime for another probe word. Materials were divided into four booklets, with each booklet containing each probe word only once, while further containing a different condition for that probe (related/unrelated word, and related/unrelated picture) to avoid repetition. Each booklet contained all four conditions across different probe words. To ensure that relatedness was examined for the correct, less-salient meaning, all words had disambiguating diacritic vowel marks. Additionally, it was ensured that none of the linguistic or pictorial primes was related to the salient meaning of the ambiguous probes.

One hundred twenty participants (80 women) rated the prime-probe relatedness on a seven-point scale, with 1 completely unrelated and 7 highly related. Each booklet contained both word-word pairs and word-picture pairs, presented in a pseudo-random order. To eliminate possible priming effects between different pairs, none of the four booklets (each rated by 30 participants) contained two sequential word-word pairs or picture-word pairs with orthographic (Carr et al., 1982) or phonological (Cutler, Sebastián-Gallés, Soler-Vilageliu, & Van Oijen, 2000) similarity. To maximize similarity with the final procedure of Experiment 1, linguistic primes were all presented on the right-hand side, according to the direction of reading in Hebrew (to be read first), with the probe on the left hand side (to be read last). For picture-word pairs the pictorial primes were presented above the probe word.

In a by-item analysis, no significant difference was found in the level of prime-probe relatedness between the pictorial and linguistic conditions; specifically, in the related condition, no difference was found between the relatedness of the linguistic (M = 5.78, SD = .70) and pictorial primes

(M = 5.77, SD = .68) to the probe word, $t < 1$. Prime-probe relatedness did not differ across the four groups of probes, neither for the related word-word pairs nor for the related picture-word pairs, $Fs < 1$. Additionally, no difference was found in the unrelated condition between linguistic primes (M = 1.49, SD = .28) and pictorial primes (M = 1.53, SD = .29), $t(75) = 1.34$, $p = .18$. Prime-probe (un)relatedness did not differ across the four groups of probes, neither for the unrelated word-word pairs nor for the unrelated picture-word pairs, $Fs < 1$.

Results further showed a significant difference in relatedness between the related and unrelated conditions both for the linguistic primes, $t(75) = 52.04$, $p < .001$, and for the pictorial primes, $t(75) = 47.21$, $p < .001$. The differences in relatedness between the related and unrelated conditions showed no effect of modality, $F < 1$. The stimulus pairs used in pretest 5 are the final pairs used in Experiments 1 and 2.

The results of all five pretests, then, allowed us to use the pretested 76 probe words—all ambiguous between homographic and heterophonic-based meanings—in Experiments 1 and 2. These probe words were paired with 152 primes, comprising 76 linguistic (word) primes, and 76 pictorial primes.

Procedure

All participants were presented with the 76 ambiguous probe words in random order. Each word followed a single prime: either a linguistic or a pictorial prime to which it was either related or unrelated (Table 1). Each participant therefore saw all four conditions, but different participants saw different probes in each of the four conditions, such that across all participants each probe word appeared in each condition with equal probability.

The experiment was split into two blocks, one made up of linguistic primes and one of pictorial primes, with half of participants presented with linguistic primes first and the other half with the pictorial primes first. Each block comprised 38 critical prime-probe pairs, 19 related and 19 unrelated, alongside 18 filler pairs with an unambiguous probe word (half related to and half unrelated to the prime), all presented in a random order. To ensure that the task was understood by all participants, at the beginning of each block six additional training pairs were presented in random order. Of these training stimuli, three probes were related to the prime (of which two were ambiguous and one unambiguous) and three were unrelated to the prime (of which two were ambiguous and one unambiguous). In total, each participant was presented 40 pairs with an ambiguous probe and 22 pairs with an unambiguous probe.

The words were displayed on a white screen, in Arial font, at 96 point. To distinguish the probe words from the primes, all primes were presented in black font, and all probe words were presented in red font. The pictorial primes, all black and white drawings, sized about 5 × 5 cm, were also presented on a white screen. Each trial began with a fixation cross displayed in the center of the screen for 500 ms, following which the prime (linguistic or pictorial) was displayed in the center of the screen for 350 ms. The prime stimulus was then replaced with the probe word, which the participant was asked to name as quickly and as accurately as possible. The RT was recorded at speech onset. At 250 ms after response onset, the probe word was replaced by a blank white screen, displayed for 1000 ms, following which the next trial was initiated.

Each participant was tested individually in the lab, with the examiner leaving the room after providing instructions and monitoring the six training trials. Participants sat straight in front of a 19-inch computer screen at a distance of 60 cm. A microphone was situated in front of them, connected to a response box that measured speech onset, next to a voice recorder that recorded participants' responses. The task lasted about 10 minutes in total.

Results and discussion

One participant was replaced due to a repeated failure of the microphone to register her responses. Responses were encoded to calculate the frequency of trials in which the participants named the salient meaning. In unclear cases, the following decisions were taken:

(1) Given that probe words were ambiguous between at least two meanings, if a third meaning was named (0.5% of trials), the response was encoded as salient, because in such cases rather than pronouncing the less salient meaning, related to the prime, these participants pronounced another meaning, which for them was most probably the salient one.
(2) When pronunciation was switched or changed partway through the response, encoding was decided on the basis of the pronunciation of the first syllable(s) (0.4% of trials).
(3) When pronunciation was a mixture of both initial vowel identity suiting the less-salient meaning and stress of the first syllable suiting the salient meaning, the response was encoded as salient (0.6% of trials). This decision was based on evidence showing that stress is the best reflection of the intended pronunciation, followed by the vowel and then the consonant (Cutler & Norris, 1988; Cutler et al., 2000).
(4) Trials with mispronunciations (0.3% of the trials) were removed from all analyses, including (a) pronunciations that mixed both salient and less-salient meanings, with the pronunciation of one syllable favoring the salient meaning and the other the less-salient meaning, such that the intended pronunciation could not be deciphered (two occurrences); (b) naming of a word unrelated to the probe, with differing phonology in both vowel and consonant (two occurrences); and (c) naming of the prime instead of the probe (one occurrence).

In addition, one probe (market/שוק) was removed from all analyses, as it was mistakenly presented with a prime related to the salient meaning, leaving 75 valid probes per participant.

A 2 × 2 ANOVA was performed both on the rate of salient responses and on median RTs for salient responses, with prime type (linguistic/pictorial) and prime relatedness (related/unrelated) as within-participant independent variables. ANOVAs were performed for both participant (F_1) and item (F_2) analyses.

As predicted by the Graded Salience Hypothesis, in Experiment 1 the salient meaning was named most frequently. In all conditions the salient meaning was pronounced more frequently (76–89% of pronunciations) than the less-salient meaning (11–24%). Nevertheless, context had an effect, albeit a limited one, on the availability of the less-salient meaning, and access to the salient meaning was reduced (by some 11%; for details see Table 2) when the prime was related to the less-salient meaning of the probe compared with when it was unrelated.

In the analysis of the rate of occurrence of the salient meaning, a significant effect of prime relatedness was found, $F_1(1,23) = 35.174$, $p < .001$, $\eta^2 = .605$; $F_2(1,74) = 29.682$, $p < .001$, $\eta^2 = .286$, with frequency being lower in the related condition ($M = .76$, $SD = .09$) than in the unrelated condition ($M = .87$, $SD = .06$). No effect was found for prime type, $F_1 < 1$; $F_2 = 1.039$, $p = .311$, $\eta^2 = .014$. There was no effect of interaction either, $F_1(1,23) = 1.036$, $p = .319$, $\eta^2 = .043$; $F_2 < 1$.

Prime relatedness also affected performance for each type of context. In the linguistic condition, a priming effect was found, showing that the use of the salient meaning was significantly less frequent in the related condition ($M = .76$, $SD = .14$) than in the unrelated condition (M = .88, $SD = .08$), $t_1(23) = 5.123$, $p < .001$; $t_2(74) = 3.221$, $p = .002$. In the pictorial condition, a priming effect was also found, with the frequency of the salient meaning being significantly lower in the related

Table 2. Experiment 1: Rate of Salient Responses and Mean RTs (SD in parentheses) by Prime Type (Linguistic/Pictorial) and Prime Relatedness (Related/Unrelated).

Prime Type Prime Relatedness		Linguistic	Pictorial	Total
Related	Rate	.76 (.14)	.76 (.08)	.76 (.09)
	RT	521 (64)	541 (89)	531 (71)
Unrelated	Rate	.88 (.08)	.85 (.07)	.87 (.06)
	RT	521 (70)	535 (101)	528 (77)
Total	Rate	.83 (.09)	.81 (.06)	
	RT	521 (63)	538 (93)	

condition (M = .76, SD = .08) than the unrelated condition (M = .85, SD = .07), $t_1(23) = 4.07$, $p < .001$; $t_2(74) = 5.117$, $p < .001$.

An analysis of the RTs by participant found no significant effect for prime type, $F_1(1,23) = 1.615$, $p = .217$, $\eta^2 = .066$, or prime relatedness, $F_1 < 1$, and no interaction between prime type and relatedness, $F_1 < 1$. A by-item ANOVA of RTs was performed on 71 of 75 valid items, because 4 items were removed due to a negligible frequency of salient responses in at least one condition. A significant effect of prime type was found, $F_2(1,70) = 23.933$, $p < .001$, $\eta^2 = .255$, with probes preceded by linguistic primes exhibiting longer RTs (M = 549, SD = 62) than probes preceded by pictorial primes (M = 515, SD = 44). No effect was found for prime relatedness, $F_2 < 1$, and no significant interaction, $F_2(1,70) = 1.19$, $p = .279$, $\eta^2 = .017$.

The results of Experiment 1, which tracked the processing of ambiguous words with controlled prime exposure duration, show, first, that the different modalities of context, whether linguistic or pictorial, affect processing in the same manner. Related primes, both pictorial and linguistic, supportive of the less-salient meaning, did facilitate activation of the less-salient meaning as compared with the unrelated prime (either linguistic or pictorial), but the salient meaning was still more likely to be named than the less-salient meaning. In this respect the results show no advantage for either prime modality. The by-item analysis of RTs showed an effect of modality. However, this does not show an effect of context modality on the priming effect, as there is no interaction between prime modality and relatedness.

These results support the Graded Salience Hypothesis and the Defaultness Hypothesis, which predict advantage of the default, salient, meaning over the nondefault, less-salient counterpart during initial processing, due to its cognitive prominence, even when contextually inappropriate (Giora, 1997, 2003; Giora et al., 2015; Peleg & Eviatar, 2008, 2008; Peleg et al., 2001). Although the context did have a facilitative effect on the less-salient meaning to which it was related, this effect was limited in scope, and the overall advantage of the salient meaning was preserved. Additionally, the lack of difference in RTs to the primed and unprimed probes also supports the Graded Salience Hypothesis, as it is consistent with the claims of limited effect of the prime stimulus (i.e., the context). Indeed, in trials in which the salient meaning was pronounced, the less-salient meaning was not activated or at least was not activated to an extent which could affect the naming times of the default salient meaning.

This raises the question of whether additional processing time could increase the effect of context. Will lengthening the exposure duration of the prime allow for the activation of the less-salient meaning, leading to a preference over the salient but inappropriate counterpart? Will an increase in exposure duration result in a difference in processing the different contexts (linguistic/pictorial)? Will such an increase affect the processing speed of the ambiguous probes, so that the less-salient meaning will be processed significantly faster than its salient alternative? These questions were addressed in Experiment 2.

Experiment 2

Experiment 1 examined whether a pictorial context would have a similar effect to that of a linguistic context given limited exposure duration of 350 ms. Results show that the two types of context indeed have a similar effect. In general, both contexts do not have an immediate effect on speeding up activation of less-salient albeit compatible meanings. Instead, salient meanings were significantly faster to activate than less-salient counterparts. However, Experiment 1 did show that the frequency of use of the salient meaning was reduced, in both modalities, in the related condition as compared with unrelated condition, which shows a limited effect of context. Will greater exposure duration increase this effect?

To examine the effect of unlimited exposure duration on priming effects, Experiment 2 tracked processing while participants had control over the exposure duration of the prime stimuli. As in Experiment 1, in Experiment 2 frequency of salient responses as well as RT will reflect the progression of processing ambiguous words and of the accessibility of the various meanings. Additionally, the participants' control over exposure duration allows an examination of the effect of context at later, perhaps nonautomatic, stages.

Methods

Participants

Twenty-four students from Tel Aviv University (15 women), aged 20 to 30 (M = 25.38, SD = 2.08), all right-handed, native Hebrew speakers, participated in exchange for payment (35 NIS). By self-report, none of them had been diagnosed with reading or visual disabilities.

Design and materials

As in Experiment 1, Experiment 2 used a 2 × 2 factorial design, with prime type (linguistic/pictorial) and prime relatedness (related/unrelated) as within-participant factors. The materials were identical to those used in Experiment 1.

Procedure

The procedure was identical to that in Experiment 1, apart from the exposure duration of the prime stimulus, which was controlled by the participants. Participants were instructed to press the response button once they had identified the prime (either a word or a picture). Once the button was pressed, a blank white screen appeared for 150 ms, followed by a probe word in red, which the participants were instructed to name.

Results and discussion

Three participants were replaced. One was replaced due to lack of response from the microphone, which did not register her responses. Two participants were replaced, as their median prime exposure duration (one in the pictorial condition and the other in the linguistic condition) was 2 standard deviations above the mean of all participants. The probe market/שוק was removed from analysis in this study, for the same reasons as in Experiment 1, leaving 75 valid probes per participant. As in Experiment 1, here too the same encoding measures for unclear responses were applied. The following decisions were taken:

(1) Given that probe words were ambiguous between at least two meanings, if a third meaning was named, the response was encoded as salient, for the same reason described in Experiment 1 (0.6% of trials).
(2) When pronunciation was switched or changed partway through the response, encoding was decided on the basis of the pronunciation of the first syllable(s) (0.4% of trials).
(3) When pronunciation was a mixture of both initial vowel identity suiting the less-salient meaning and stress of the first syllable suiting the salient meaning, the response was encoded as salient (0.1% of trials). This decision was based on evidence showing that stress is the best reflection of the intended pronunciation, followed by the vowel and then the consonant (Cutler & Norris, 1988; Cutler et al., 2000).
(4) Trials with mispronunciations (0.2% of the trials) were removed from all analyses: one occurrence of an unclear response, one occurrence of a word in which one syllable was pronounced as in the salient meaning, one as in the less-salient meaning, and one occurrence of a nonexistent word.

There was no significant difference between the self-paced exposure duration to linguistic (M = 593, SD = 222) and pictorial (M = 656, SD = 330) primes, $t_1(23) = 1.68$, $p = .106$. A 2 × 2 ANOVA was performed both on the rate of salient responses and on median RTs in trials with salient responses, with prime type (linguistic/pictorial) and prime relatedness (related/unrelated) as within-participant variables. ANOVAs were performed for both participant (F_1) and item (F_2) analyses.

As in Experiment 1, in Experiment 2 the salient reading preserved its advantage. In all conditions the salient meaning was named more frequently (68–91%) than the less-salient one (9–32%).

Table 3. Experiment 2: Rate of Salient Responses and Mean RTs (SDs in parentheses) by Prime Type (Linguistic/Pictorial) and Prime Relatedness (Related/Unrelated).

Prime Type Prime Relatedness		Linguistic	Pictorial	Total
Related	Rate	.68 (.12)	.68 (.15)	.68 (.10)
	RT	548 (108)	551 (99)	550 (96)
Unrelated	Rate	.86 (.08)	.91 (.06)	.89 (.05)
	RT	557 (109)	568 (109)	562 (104)
Total	Rate	.77 (.08)	.80 (.08)	
	RT	553 (107)	560 (101)	

However, the context had a facilitative effect on the less-salient meaning, which significantly reduced the frequency of the salient responses (by some 21%; for details see Table 3).

An ANOVA of the rate of salient responses showed a significant effect of prime relatedness, $F_1(1,23) = 79.775$, $p < .001$, $\eta^2 = .776$; $F_2(1,74) = 95.829$, $p < .001$, $\eta^2 = .564$, with salient responses being less frequent in the related condition ($M = .68$, $SD = .10$) than in the unrelated condition ($M = .89$, $SD = .05$). Prime type did not have a significant effect, $F_1(1,23) = 1.4$, $p = .249$, $\eta^2 = .057$; $F_2(1,74) = 1.503$, $p = .224$, $\eta^2 = .02$. Nor was there a significant interaction between the two, $F_1(1,23) = 1.854$, $p = .186$, $\eta^2 = .075$; $F_2(1,74) = 2.027$, $p = .159$, $\eta^2 = .027$.

A priming effect was found in the linguistic condition, such that the salient responses were less frequent in the related condition ($M = .68$, $SD = .12$) than in the unrelated (M = .86, $SD = .08$), both by-participant, $t_1(23) = 6.904$, $p < .001$, and item analyses, $t_2(74) = 8.556$, $p < .001$. A similar effect was found in the pictorial condition, with a lower frequency of salient responses in the related condition ($M = .68$, $SD = .15$) than in the unrelated condition ($M = .91$, $SD = .06$), $t_1(23) = 6.852$, $p < .001$; $t_2(74) = 6.119$, $p < .001$.

In a by-participant ANOVA on the median RTs of salient responses, no effect was found for prime type, $F_1 < 1$, neither was a significant interaction found, $F_1 < 1$. However, a marginally significant effect was found for prime relatedness, $F_1(1,23) = 4.097$, $p = .055$, $\eta^2 = .151$, with a shorter RT for the related ($M = 550$, $SD = 96$) than the unrelated (M = 562, $SD = 104$) condition.

A by-item ANOVA of the RTs was performed on 67 of the 75 valid items. Eight items were removed from analysis due to a negligible salient response rate. No effect was found for prime type, $F_2 < 1$, for prime relatedness, $F_2 < 1$, or for their interaction, $F_2(1,66) = 1.832$, $p = .181$, $\eta^2 = .027$.

The results of Experiment 2 show that even when participants are given the opportunity to independently and individually control the exposure duration of the prime, there is no effect of modality on the exposure duration chosen. The pictorial and linguistic contexts, both equally supportive of the less-salient meaning, were processed in a similar timeframe and had a similar effect on the facilitation of the less-salient meaning of ambiguous words or on the inhibition of the inappropriate but salient meanings. As in Experiment 1, then, no advantage was found for either prime type (linguistic or pictorial).

The results of this experiment also evidence priming of the less-salient, contextually appropriate meaning. However, even when the exposure duration of the prime that facilitates the less-salient reading was controlled by the participants, the relative advantage of the salient meaning was preserved and in most cases was activated rather than inhibited. The cognitive prominence of the salient meaning makes it difficult to inhibit or overcome. These results support the Graded Salience Hypothesis and the Defaultness Hypothesis.

Although we do not have a concrete explanation for the marginal significance of relatedness on RTs, with faster responses in the related than the unrelated condition, it may be because words pronounced with the salient meaning (despite the prime that prompts the less-salient meaning) are those for which the salient meaning is most quickly activated, regardless of deliberate unlimited exposure duration of context.

Comparing Experiments 1 and 2

The results of Experiments 1 and 2 show that despite differences in exposure duration of the prime—a controlled and limited duration of 350 ms in Experiment 1 and a self-paced duration (of around 600 ms and longer, with an additional 150 ms interstimulus interval) in Experiment 2—prime relatedness had a similar and significant effect. Participants were less likely to pronounce the salient meaning in the related condition, where the prime facilitated the less-salient meaning, as compared with the unrelated condition. To examine the different stages of processing ambiguity in both the initial automatic stage (Experiment 1) and the later stage (Experiment 2), the two experiments were compared. To that end we ran a 2 × 2 × 2 ANOVA on the rate of salient responses, both by-participant (F_1), with experiment (1, 2) as a between-participant variable, and prime type (linguistic/pictorial) and prime relatedness (related/unrelated) as within-participant variables, and by-item (F_2), with all variables as within-item variables (Tables 2 and 3). These analyses show an interaction of experiment and prime relatedness, $F_1(1,46) = 12.124$, $p = .001$, $\eta^2 = .209$; $F_2(1,74) = 16.035$, $p < .001$, $\eta^2 = .178$. A simple-effects analysis showed that participants were less likely to use the salient response in the related condition in Experiment 2, when the exposure duration was not limited ($M = .68$, $SD = .10$) than in the related condition in Experiment 1, when the exposure duration was limited ($M = .76$, $SD = .09$), $t_1(46) = 3.007$, $p = .004$; $t_2(74) = 4.231$, $p < .001$. However, in the unrelated condition there was no significant difference in the likelihood of using the salient meaning in Experiment 1 ($M = .87$, $SD = .06$) and Experiment 2 ($M = .89$, $SD = .05$), $t_1(46) = 1.145$, $p = .258$; $t_2(74) = 1.143$, $p = .257$. The only other significant effect was a main effect for prime relatedness, so that the rate of salient responses was reduced in the related condition as compared with the unrelated condition, $F_1(1,46) = 114.423$, $p < .001$, $\eta^2 = .713$; $F_2(1,74) = 88.409$, $p < .001$, $\eta^2 = .544$.

In a by-participant 2 × 2 × 2 ANOVA on the RTs in trials with salient responses, with prime type (linguistic/pictorial) and prime relatedness (related/unrelated) as within-participant factors and experiment (1, 2) as a between-participant factor, a marginally significant interaction was found between experiment and prime relatedness, $F_1(1,46) = 3.36$, $p = .073$, $\eta^2 = .068$. Simple effects analysis showed that while RTs did not differ between the related ($M = 531$, $SD = 71$) and unrelated ($M = 528$, $SD = 77$) conditions in Experiment 1, $t_1 < 1$, in Experiment 2 RTs were marginally significantly shorter in the related condition ($M = 550$, $SD = 96$) than in the unrelated condition ($M = 562$, $SD = 104$), $t_1(24) = 1.983$, $p = .059$. All other effects failed to reach significance, p's > .203.

In a by-item analysis a significant main effect was found for experiment, with shorter RTs in Experiment 1 ($M = 527$, $SD = 45$) than in Experiment 2 ($M = 565$, $SD = 60$), $F_2(1,63) = 48.607$, $p < .001$, $\eta^2 = .436$. Additionally, a main effect was found for prime type, with longer RTs following a linguistic prime ($M = 553$, $SD = 56$) than a pictorial one ($M = 540$, $SD = 46$), $F_2(1,63) = 6.71$, $p = .012$, $\eta^2 = .096$.[6] Additionally, a significant interaction was found between prime type and experiment, $F_2(1,63) = 5.178$, $p = .026$, $\eta^2 = .076$, showing that in Experiment 1, RT was longer following the linguistic ($M = 541$, $SD = 57$) than the pictorial prime ($M = 514$, $SD = 44$), $t_2(63) = 3.99$, $p < .001$, whereas in Experiment 2 there was no significant difference between the linguistic ($M = 565$, $SD = 73$) and the pictorial conditions ($M = 566$, $SD = 63$), $t_2 < 1$. No other effects were significant, p's > .377.

A comparison of the two experiments shows that at the initial automatic stages of processing (see Experiment 1), although both prime types (linguistic/pictorial) facilitated the less-salient meaning, the salient meaning was still significantly more frequently activated than the less-salience meaning. This advantage for the salient meaning over the less-salient is reduced, but preserved, when participants are given longer exposure to the prime (Experiment 2). These results, showing the superiority of the salient meaning, irrespective of context type and strength, support the predictions of the Graded Salience Hypothesis and the Defaultness Hypothesis. The very fact that two meanings are part of both early and late stages of the processing and the possibility that they are not inhibited allows for interplay of ambiguous meanings.

General discussion

In this study we tested the predictions of the Graded Salience Hypothesis (Giora, 1997, 2003) and the Defaultness Hypothesis (Giora et al., 2015) with regard to the effect of contexts of different modalities, linguistic and pictorial, on processing ambiguous words. According to both theories, both types of primes/contexts will have similar effects on disambiguation of linguistic probes, expecting the default salient meaning to be activated initially and exclusively, regardless of prime/contextual information; less salient meanings will lag behind. To test these predictions, we looked into the processes involved in interpreting multimeaning words, preceded by linguistic and pictorial primes respectively.

Both experiments, examining the effect of linguistic and pictorial contexts, support the Graded Salience Hypothesis (Giora, 1999, 2003) and the Defaultness Hypothesis (Giora et al., 2015). As predicted, they attest to the speed superiority of default salient yet contextually inappropriate meanings over nondefault less-salient yet appropriate ones. In Experiments 1 and 2, despite contexts' clear facilitative effects on the activation of the nondefault less-salient meaning, this effect was limited, such that the overall prominence of the salient meaning was preserved. The default salient meaning was activated automatically, irrespective of contextual information, which did not inhibit the activation of the salient meaning. Although the less-salient meaning benefitted from contextual support and could also benefit from the extra processing time, it did not supersede the primacy of the salient meaning (as shown by Experiment 2).

These results argue against the Direct Access View (Gibbs, 1994; Martin et al., 1999; Vu et al., 1998, 2000), according to which strong context plays a primary role from a very early processing stage, resulting in an immediate interaction between linguistic and extralinguistic knowledge. According to this model, irrelevant meanings are inhibited and do not reach a threshold (Vu et al., 1998). However, the results of both experiments described here do not support the predictions of the Direct Access View, which proposes a single mechanism, sensitive to both linguistic and extralinguistic knowledge.

Our findings, which point to two distinct processing mechanisms, are not quite in line with the Reordered Access Model either. According this view, no precedence of the salient meaning over the less-salient meaning is predicted. According to this model, both meanings should be equally accessible. On the one hand, context should facilitate activation of the less-salient but contextually appropriate meaning; on the other, it should not inhibit activation of the salient meaning (Binder & Rayner, 1998, 1999; Duffy et al., 1988; Frazier & Rayner, 1990; Rayner et al., 1994). Indeed, whereas the salient, contextually inappropriate meaning is not inhibited here, the less-salient contextually appropriate meaning is not facilitated to the same extent as the salient one; instead, it lags behind (as shown by Experiments 1 and 2).

Our results, indicating an initial, automatic processing stage, which is insensitive to contextual information, and a later, context-sensitive stage, which somewhat affects comprehension, support the view that lexical effects and contextual effects are two distinguishable processes, insensitive to context modality (whether linguistic or pictorial). They thus partially support the modular approach (Fodor, 1983), consisting of two distinct modules (i.e., top-down and bottom-up processes). Still, unlike the Modular View, our results do not support an automatic exhaustive access of all the meanings listed in the mental lexicon, regardless of degree of salience. Instead, they support a serial access model, sensitive to degree of salience.

Our results show that, as predicted, during initial processing, context does not affect lexical access (Giora, 2003; Peleg & Eviatar, 2008, Peleg et al., 2001). The central claim of the Graded Salience and Defaultness Hypotheses is that meanings are activated as an automatic response to a stimulus (here the probe-word), based on its degree of defaultness. Additionally, a strongly supportive context might predict an oncoming word/meaning but cannot inhibit the activation of the default salient meaning, even when contextually inappropriate (Giora, 2003; Peleg & Eviatar, 2008, Peleg et al., 2001).

Both experiments described here allow a comparison of different types of primes to better understand the relations between words and pictures and an examination of the (lack of) differences

between linguistic and pictorial contexts. This study has broadened our perspective with regard to the interaction between words and pictures by using a cross-modal semantic priming paradigm (see also Bajo, 1988; Bajo & Cañas, 1989; Carr et al., 1982; Kircher et al., 2009; Sperber et al., 1979, Vanderwart, 1984). They attest to the similar priming effects of (equivalent) image and word, suggesting that, at least initially, lexical access is insensitive to both.

In sum, these innovative results show that linguistic and pictorial contexts have a similar effect on ambiguity resolution. In future research it will be interesting to investigate linguistic ambiguity (see Giora, Heruti, Metuki, & Fein, 2009; Giora et al., 2017) in creative pictorial contexts such as advertisements or works of art (Heruti, 2015), in terms of the psycholinguistic and cognitive study of language.

Notes

1. The *Defaultness Hypothesis* (Giora et al., 2015) is an umbrella theory, which further includes the *Graded Salience Hypothesis* (Giora, 1997, 2003) and the *Default Non-literal Utterance Interpretation* theory (Giora, 2015; Giora et al., 2013).
2. The terminology used in the literature at the time relates to *dominant* and *subordinate* meanings. These are equivalent to *default* and *nondefault* meanings or *salient* and *less-salient* meanings, both of which are used here (see Giora, 2003; Giora et al., 2015).
3. Cross-modality is most commonly used to describe a paradigm that uses two types of stimuli: linguistic (auditory), pictorial or linguistic (written). However, viewing pictures and reading words are both done in the visual modality. Some have used the term cross-form to refer to joint pictorial and written stimuli, but this is not the standard practice. Therefore, we use the term modality and cross-modal in the current study.
4. An exceptional case is a context that allows one to predict the oncoming word and/or its meaning (see Peleg et al., 2001).
5. The list of probe words was mainly based on the controlled list from Peleg and Eviatar (2008). As a follow up, a series of pretests investigated the various meanings as processed without context.
6. The difference between RTs following linguistic and pictorial priming is in line with previous results that show faster responses for picture-word pairs than word-word pairs (Carr et al., 1982; Sperber et al., 1979). However, this effect does not signify greater priming effects, as there is no interaction between modality and relatedness.

Disclosure statement

No potential conflict of interest was reported by the authors.

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