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RESISTING CONTEXTUAL INFORMATION: YOU CAN'T PUT A SALIENT MEANING DOWN[1]

Abstract
Two experiments support the graded salience hypothesis (Giora 1997, 1999, 2003; Peleg et al. 2001, 2004), which assumes that early processing involves distinct mechanisms–linguistic and contextual–that do not interact but run parallel. While contextual processes make up an integrative, top-down mechanism that benefits from linguistic and extra-linguistic information, the linguistic mechanism is modular (Fodor 1983). Using Vu et al.'s (2000) materials, Experiment 1 shows that the sentential position of a target word (initial vs. final) is crucial for the operation of the global, predictive mechanism, whose effects, accumulated in prior discourse, mask lexical effects in final, but not in initial position. Experiment 2 shows that even in a sentential position that favors contextual effects (i.e. sentence final position, see Peleg et al. 2001, 2004), lexical access is not affected: Salient meanings are activated upon encounter of the lexical stimulus, regardless of contextual information to the contrary. Taken together, these findings argue against direct access models, which suggest that context can selectively activate the appropriate meaning, regardless of salience (see Vu and Paul 1998; Vu et al. 2000).

Keywords
Graded salience hypothesis, sentential position, context effects, predictive context, ambiguity resolution.

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1. Introduction

At first sight, the assumption that human cognition is economical or efficient seems plausible and even appealing. Indeed, it is intuitively engaging to conceive of ourselves as paying attention "*only* to information that seems *relevant* to us" (Smith and Wilson 1992: 4, emphases added), that is, to information that is somehow related to our set of contextual assumptions so that it can combine with it and yield contextual effects (Sperber and Wilson 1986/95). Such view of the mind assigns to contextual information the role of a gatekeeper. It determines what will be processed and which interpretations will be derived,[2] filtering out information deemed irrelevant. Thus, upon processing

(1) The gardener dug a hole. She inserted the bulb.

comprehenders should activate the compatible "flower" meaning of *bulb* exclusively, since this is the only interpretation of *bulb* that would yield contextual effects. In contrast, the "light" sense of *bulb* should not be activated, since, in the set of accessible assumptions, it is irrelevant.

Quite a number of cognitive scientists and psycholinguists believe that the mind is flexible enough to accommodate contextual information to the extent that, when sufficiently constraining, it dominates comprehension entirely. This view, dubbed *the direct/selective access model*, assumes that human cognition is governed by a single, interactive mechanism that benefits from both linguistic and extra-linguistic information which activates compatible interpretations exclusively, so that comprehension proceeds seamlessly and effortlessly. Recent findings seem to corroborate this model. They show that, in a highly specific context such as (1), only compatible meanings were made available (Vu and Paul 1998; Vu et al. 2000; for an extensive review of the literature on the direct/selective access model, see Giora 2003; Gorfein 1989; Simpson 1994; Small et al. 1988).

The direct/selective access view argues against a modular assumption according to which language processes are autonomous and initially insensitive to contextual information (Fodor 1983; Forster 1979). Consequently, lexical access is exhaustive; all the meanings of an ambiguous word are activated even though context might be biased in favor of one meaning only. Though context effects might be speedy, they only affect the output of the lexical module (for an extensive review of the literature on the exhaustive access model, see Giora 2003; Gorfein 1989; Peleg et al. 2001; Simpson 1994; Small et al. 1988).

[2] Depending also on the cost involved.

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Following Fodor (1983), our research proposes an alternative view of the mind as less compliant and maybe less economical than envisaged by the direct access view. Instead of positing a single device, the graded salience hypothesis we assume (Giora 1997, 1999, 2003; Peleg et al. 2001) suggests that comprehension involves distinct mechanisms–linguistic and contextual–that run parallel without interacting initially. While contextual processes make up a global, top-down mechanism that integrates linguistic and nonlinguistic information, the linguistic mechanism is modular; it is automatic and impervious to context effects. Being stimulus driven, this bottom-up machinery is encapsulated and does not feed on information outside the module, and consequently does not conform to contextual information. It therefore allows the processor to also activate apparently incompatible, irrelevant information.

Specifically, the graded salience hypothesis assumes that contextual information may affect comprehension immediately and avail contextually appropriate concepts via inferential, guessing, or predictive processes, yet without interacting with lexical access. As a result, it cannot block salient but incompatible meanings. Salient meanings–coded meanings foremost on our mind due to familiarity, conventionality, frequency, or prototypicality–would always be activated when the lexical stimulus is encountered, irrespective of context (Giora 2003; Peleg and Eviatar 2008ab). Lexical access is exhaustive (as suggested by Fodor 1983) yet ordered: Salient meanings are activated faster than less-salient ones (see also Duffy et al. 1988; Rayner et al. 1994). If the outputs of contextual and lexical processes accidentally match, speedy integration processes are anticipated. If, however, they accidentally mismatch, less speedy lexical processes may reach a threshold. The involvement of irrelevant meanings is thus a consequence of an encapsulated mechanism whose course of action (e.g. lexical access) is blind to information outside the module.

In various respects, the graded salience hypothesis seems akin to "the re-ordered access model," which accommodates an exhaustive access procedure that is sensitive to both lexical (i.e. degree of salience) and contextual information. According to this view, comprehenders' prior experience with the ambiguous word may render one meaning more salient and accessible than others so that that meaning is accessed faster, regardless of context. In addition, prior semantic information may be strong enough to immediately activate the contextually appropriate meaning, even when less salient (Duffy et al. 1988; Rayner et al. 1994). Thus, similarly to the graded salience hypothesis, this hybrid model predicts that salient meanings are always activated, regardless of context. However, the re-ordered access view does not deal with the mechanism by which contextually appropriate meanings are made immediately available, nor does it account for why salient meanings are automatically activated even when prior context is biased towards the less-salient meaning. With respect to the contextual mechanism, then, the graded salience hypothesis diverges from the re-

ordered access view since it does not allow contextual processes to interact with lexical access (for an in-depth review of the re-ordered access model, see Giora 2003).

How does the graded salience hypothesis, then, account for evidence to the contrary suggesting that only contextually compatible meanings are tapped (Vu and Paul 1998; Vu et al. 2000)? In Peleg et al. (2001, 2004), we propose that such findings are not necessarily the outcome of an interactive mechanism, but may have an alternative explanation. While apparently attesting to selective access, these results might be exclusively induced by the integrative, expectation-driven mechanism, without affecting lexical access at all. In Peleg et al. (2001), we show that contextual information may have fast effects, such that occur even before the lexical stimulus is encountered, thus fostering an impression of direct access. This is particularly true when the stimulus is placed at the end of a highly specific sentential context, allowing for guessing and inferential processes to have a speedy effect. Indeed, replication of Vu et al.'s (1998) study with probes placed immediately before (see * in 2-3 below), instead of immediately after the final target word, yielded the same results as Vu et al.'s (see Peleg et al. 2001, Ex. 1). Such replication makes Vu et al.'s conclusion suspect and alludes to the possibility that context need not interact with lexical accessing in order to avail the appropriate meaning:

(2) The slugger splintered the* bat.
(Probes displayed at *: salient-wooden; less-salient-fly; unrelated-station)

(3) The biologist wounded the* bat.
(Probes displayed at *: salient-wooden; less-salient-fly; unrelated-station. Manipulated items taken from Vu et al. 1998)

In addition to showing that contextually appropriate meanings can be made available by the central, predictive mechanism, irrespective of and even before lexical processes are invited, we further demonstrate that coded but contextually inappropriate meanings are also made available swiftly; they get activated automatically by the modular mechanism, irrespective of contextual fit (Peleg et al. 2001, Ex. 2).

Specifically, in Peleg et al. (2001, Ex. 2), we used two-sentence passages whose targets had salient and nonsalient (noncoded) contextually compatible meanings inferable from prior context. Participants had to make lexical decisions to probes which were related either to the salient contextually inappropriate meaning ("criminals") or to the nonsalient but contextually appropriate meanings ("kids") of the targets ("delinquents"). The probes were displayed immediately following the offset of the targets, which were presented either at the beginning (4) or at the end of the last sentence (5):

(4) Sarit's sons and mine went on fighting continuously. Sarit said to me: These delinquents* won't let us have a moment of peace.
(Probes displayed at *: Salient-criminals; Contextually compatible-kids; Unrelated-painters)

(5) Sarit's sons and mine went on fighting continuously. Sarit said to me: A moment of peace won't let us have these delinquents*.[3]
(Probes displayed at *: Salient-criminals; Contextually compatible-kids; Unrelated-painters)

Results support the distinct mechanisms hypothesis. They show priming for both meanings in both positions (initial and final). However, in the final position, the nonsalient but contextually compatible meaning is more highly activated than the salient inappropriate meaning, suggesting that in final position, contextually compatible meanings reach sufficient levels of activation faster than salient but inappropriate meanings (as shown also by Peleg et al. 2001, Ex. 1 and by Vu and his colleagues). Findings, however, further demonstrate that activation of contextually appropriate meanings is not exclusive. Rather, salient but inappropriate meanings were activated as well, in spite of contextual misfit. Such findings demonstrate that, as predicted by the graded salience hypothesis, in addition to contextual mechanisms, modular, bottom-up mechanisms are at work as well: Though final position benefits the contextual mechanism, its effects do not interact with lexical processes and do not block salient but inappropriate meanings. Results from Peleg et al. (2001) then support the distinct mechanisms hypothesis.

In this study we aim to adduce more evidence in favor of the distinct mechanisms hypothesis. While in Peleg et al. (2001) we looked into salient and nonsalient meanings, in this study, we focus on salient and less-salient meanings of ambiguous words. Experiment 1 was therefore designed to show that, in sentence initial position, previous context, biased in favor of the less-salient meaning of an ambiguous word, is not fast enough to eclipse salience effects. Experiment 2 was designed to show that even in sentence final position, a rich context, biased toward the less-salient meaning of an ambiguous word, is ineffective in blocking salient meanings (see also Peleg et al. 2001, Ex. 2).

2. Experiment 1

[3] The word ordering in Hebrew is such that the target NP occupies initial position, preceding the demonstrative:
The *delinquents* these won't let us have a moment of peace.
A moment of peace won't let us have the *delinquents* these.

Although previous work suggests that context may be strong enough to predict the contextually appropriate meaning very early on, even before the target word is encountered (Peleg et al. 2001, Ex. 1), there is not enough evidence to demonstrate that such context does not, in effect, constrain lexical access when this eventually occurs, as maintained by Vu and his colleagues.

Recall that theories positing a single, interactive mechanism assume that "constraining" contexts interact with lexical processing and inhibit activation of irrelevant or inappropriate meanings. A strongly "constraining" context is obtained by manipulating the level of specificity of lexical constituents. Consistent with multiple constraint-based approaches (e.g. McClelland 1987; McRae et al. 1998), Kellas, Vu, and colleagues proposed that individual lexical components in an input stream can provide a source of constraint on lexical processing. Their studies showed that contexts which included non-specific lexical categories (e.g. *He located the* ***bat***.) primed both meanings of the final-homonym. However, when contexts included specific lexical constituents (e.g. *The biologist wounded the* ***bat***. or *The slugger splintered the* ***bat***.), only contextually appropriate meanings of targets were primed, whether or not the salient or the less-salient meaning was invited by the context.

To provide for an alternative explanation based on the distinct mechanism hypothesis, we attempted to replicate Vu et al.'s (2000) results, using their items, manipulating, however, the targets' sentence position. We predicted that even a highly "constraining" context would not inhibit salient meanings of targets presented at the *beginning* of sentences. This prediction is inconsistent with interactive models, which assume that, in a rich and supportive context (provided by the previous sentence context), the appropriate meaning is tapped initially, directly, and exclusively, without involving incompatible meanings at all. We thus aimed to demonstrate that when the same lexical constraints produce a less-predictive context, the contextually intended meaning would not be accessed selectively. Based on the findings obtained in Peleg et al. (2001, Ex. 2), we assumed that the expectation-driven mechanism would operate most efficiently toward the end rather than at the beginning of sentences or clauses.

Indeed, review of the literature indicates that often a selective access of the less-salient but compatible meaning was obtained when the ambiguous word was embedded in sentence final position (e.g. van Petten and Kutas 1987; Vu and Paul 1998; Vu et al. 2000). In contrast, when the critical ambiguous words were presented at the beginning of sentences or clauses, salient but incompatible meanings immediately surfaced despite prior disambiguating contextual information to the contrary (e.g. Gibbs 1990; Duffy et al. 1988).

The graded salience hypothesis thus predicts that the same lexical constraints, used by Vu et al. to bias their contexts toward the less-salient meaning of the critical ambiguous words, would neither inhibit nor precede lexically accessing of

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salient but inappropriate meanings at the beginning of sentences. Since there is no controversy regarding the (apparently) selective activation of salient contextually appropriate meanings, only the passages biased toward the less-salient meaning were chosen.

To manipulate sentence (initial/final) position, the second sentence of Vu et al.'s (2000) (e.g. She inserted the bulb.) was subjected to passivization:

(6) The gardener dug a hole. The *bulb* *was inserted.
(Target words displayed at *: salient-LIGHT; less-salient-FLOWER; unrelated-CLIFF)

Given such contexts, it was predicted that, in initial position, polarized ambiguous words (words having salient and less-salient meanings) would yield the following order of meaning activation:

(i) salient but inappropriate meanings of probes would be activated initially (by the lexical mechanism);
(ii) contextually appropriate meanings of probes would be made available concurrently or somewhat later (by the predictive mechanism).

On the other hand, in final position, such ambiguous words would yield a different order of meaning activation:

(i) contextually appropriate meanings of probes would be activated initially (by the predictive mechanism);
(ii) salient, but inappropriate meanings of probes would be accessed concurrently or somewhat later.

Sixty native speakers of English read the original and the passivized versions of Vu et al.'s (2000) discourses and were administered lexical decision tasks.

2.1. Method

Design. A 2 x 3 factorial design was used with probe position (initial/final) and probe type (salient/less-salient/unrelated) as within-subject/items factors.

Participants. Sixty native speakers of English (32 women and 28 men), ranging from 20 to 37 years old, served as paid participants. They were students of the medical school of Tel-Aviv University (special program for North American students).

Stimuli. Twenty-four texts biased toward the less-salient meaning of the homonyms were selected from the 96 texts used by Vu et al. (2000). Screening was

determined according to the feasibility of their passive transformation and in keeping with Binder and Rayner's (1998, 2000) and Rayner et al.'s (1999) criticism of some of the materials used by Vu et al. (See Appendix A).

To establish saliency of meanings, we conducted a pretest in which the 24 homonyms were presented in a neutral context (Vu et al.'s second sentence only, see 7) and tested for the saliency of the probes. Given the neutral context, the targets were ambiguous between the to-be contextually compatible (Vu et al.'s subordinate meaning) and incompatible meanings (Vu et al.'s dominant meaning).

2.2. Pretest

Design. A simple design was used, with only one within-subject/factor-probe type (salient/less-salient/unrelated).

Participants. Twenty-four native speakers of English acted as paid participants. Nine were students of Tel-Aviv University (special program for North American students) and 15 were North American teachers of English from Tel Aviv Open University, aged 24-46.

Stimuli. Materials were 24 homonyms presented in neutral sentence contexts:

(7) She inserted the bulb.*
(Probe displayed at *: Incompatible-light; Compatible-flower; Unrelated-cliff).

Procedure. Participants read sentences off a monitor screen. Immediately (0 msec) after offset of the final word (*bulb*), a probe was displayed (at *, see 7 above), either related to the to-be incompatible meaning of the target ("light"), or to the to-be compatible meaning ("flower"), or was unrelated to any of the senses of the word ("cliff"). Each participant saw each sentence only once, followed by one of the three probes. Twenty-four additional sentences were constructed and served as fillers. They were always presented with a non-word probe. Presentation and response collection were controlled by a Pentium PC, using a C++ program.

2.3. Results

We averaged the response times (RTs) of all trials in each condition. Means and standard deviations of RTs for correct responses for the three conditions are presented in Table 1. We ran subject (F_1) and item (F_2) ANOVAs and used three planned comparisons between means for each. There was a significant difference between the to-be contextually incompatible meaning and the unrelated probe, $F_1(23)=3.92$, $p<.001$, $F_2(23)=4.63$, $p<.0005$ and between the to-be contextually

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compatible and unrelated probes, $F_1(23)=2.78$, $p<.05$, $F_2(23)=2.74$, $p<.05$. There was also a significant difference between the to-be incompatible and compatible probes in the item analysis, $F_2(23)=2.13$, $p<.05$, but not in the subject analysis, $F_1(23)=1.62$, $p=.12$. The results established the relative salience of the prospective incompatible - salient - and compatible - less-salient - meanings compared to the unrelated meaning.[4]

Table 1. Mean Response Times (in Milliseconds) to Probes in neutral sentence contexts – in the pretest of Experiment 1

Salient Probe		Less-Salient Probe		Unrelated Probe	
M	SD	M	SD	M	SD
777	176	811	172	852	178

Procedure. Participants were tested individually. They were first given instructions and had three training trials to make sure they understood the task. The experiment included 48 experimental trials (of which 24 were filler trials involving a non-word probe). Stimuli were displayed word by word across the computer screen at a pace established previously for each participant by a pretest (see below). The words remained visible until the probe was displayed in screen-center position and reappeared after the subject had made a lexical decision as to whether a letter string (the probe) was a word or a non-word in English. The participants responded by pressing one of two (yes/no) keys. The final word of the sentence was then added. In 25% of the cases, a yes/no comprehension question was also displayed. The latency between the onset of the probe and the pressing of the key was measured by the computer and served as response time (RT).

To establish the individual pace of presentation of stimuli, a pretest was run immediately before the actual experiment in which each participant read ten sentences off the computer screen. The reading time per word was recorded and averaged by the computer and served as the reading pace of the experimental sentences for that individual.

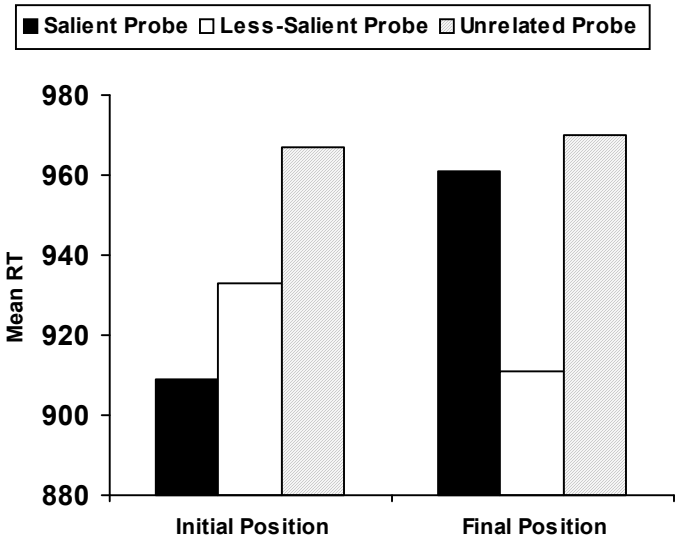
[4] Interestingly, Vu et al. (1999) reported no difference at all between the salient (dominant) and less-salient (subordinate) meanings when tested in a neutral context. Given these results, it seems safe to conclude that the targets used by Vu et al. were actually balanced rather than polar ambiguities. This fact by itself explains their findings as compatible with the graded salience hypothesis as well as the re-ordered access model (see Rayner et al. 1994).

Means and standard deviations for the six conditions are presented in Table 2 and illustrated by Figure 1. The ANOVAs included two within-subject/item factors: Target position (initial/final) and probe type (salient/less-salient/unrelated). We conducted 6 planned comparisons between means.

Table 2. Mean Response Times (in Milliseconds) to Probes by sentence position – Experiment 1

	Salient Probe		Less-Salient Probe		Unrelated Probe	
Target Position	M	SD	M	SD	M	SD
Initial Position	909	254	933	241	967	198
Final Position	961	258	911	224	970	256

Figure 1. Mean Response Times (in Milliseconds) to Probes Related to the Salient (contextually incompatible) and Less-salient (contextually compatible) Meanings of the Target Words, and Unrelated Probes in Experiment 1



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2.3.1. Initial position

In sentence initial position, there was a significant difference between the RTs to the salient and to the unrelated probe, $F_1(1,59)=6.77$, $p<.05$, $F_2(1,23)=9.49$, $p<.01$. The difference between the less-salient probe and the unrelated probe was also significant (in the item analysis), $F_1(1,59)=2.03$, $p=.16$, $F_2(1,23)=4.57$, $p<.05$. The difference, however, between the salient and the less-salient meanings did not reach significance.

2.3.2. Final position

In sentence final position, the difference between the less-salient and the unrelated probe was significant (in the subject analysis), $F_2(1,59)=5.23$, $p<.05$, $F_1(1,23)<1$. The difference between the less-salient and the salient probes was also significant (in the subject analysis), $F_2(1,59)=6.78$, $p<.05$, $F_1(1,23)<1$. However, there was no significant difference between the salient and the unrelated probe.
A 2x2 ANOVA (without the unrelated probes) revealed a significant interaction between position and probe (in the subject analysis), $F_2(1,59)=4.94$, $p<.05$.

2.4. Discussion

The above results are consistent with our view that language comprehension involves independent mechanisms that operate in parallel. Sentence position (initial/final) helps tease apart their respective effects, since it affects the speed of the top-down, contextual mechanism. The expectation-driven mechanism is faster toward the end than at the beginning of sentences, where different types of constraints (pragmatic, semantic, and syntactic) enable it to better predict an upcoming concept and thus activate compatible meanings even before the relevant lexical stimulus is encountered (as shown by Peleg et al. 2001). However, in sentence initial position, only constraints from previous context can be operative, which makes it somewhat harder for the predictive mechanism to come up with the next concept before lexical accessing occurs. Being somewhat slower than in final position, its speed in initial position does not obscure the effects of the lexical mechanism, thus disclosing the involvement of different mechanisms in initial comprehension processes (for similar findings regarding activation of salient but unintended meanings in sentence initial position, see Dopkins et al. 1992; Gibbs 1990).

These findings, particularly those obtained in sentence initial position, cannot be accounted for by the context-sensitive, interactive model, which predicts that, given enough constraints, only the compatible meaning of an ambiguous word will

be activated. According to Vu et al. (1998), the grammatical subject noun alone could lead to exclusive priming of contextually appropriate probes. In one of their studies, only the subject noun of a neutral context preceding an ambiguous word was manipulated. For each homonym (*arms*), three sentences were created, one biasing it toward the dominant (salient) meaning of the ambiguous word (*The physician cleaned his* ***arms***.), another biasing it toward the subordinate (less-salient) meaning of the word (*The marksman cleaned his* ***arms***.), and a neutral sentence (*The man cleaned his arms.*). Results showed priming for both meanings following the neutral context, but exclusive priming of the contextually appropriate meaning ("hands"/"weapons") following the biasing contexts, regardless of salience.

In our study, subjects read the first sentence (*The gardener dug a hole*.) and the ambiguous target word (***The bulb***...) before the probe was presented (in sentence initial position), thus adding more constraints to those found in Vu et al. (1998). According to the context-sensitive model, the entire preceding sentence context plus the (ambiguous) word of the target sentence should have been more than "enough" to prime the contextually appropriate probe ("flower") exclusively. Nevertheless, our findings demonstrate that, in initial position, the incompatible but salient probe ("light") was primed as well (and somewhat more swiftly even).

In conclusion, the results of this study demonstrate that, in initial position, salient meanings are activated by the lexical mechanism, irrespective of contextual information to the contrary. Sentence non-initial position, however, did not support the encapsulated hypothesis, prompting the need for further investigation. To demonstrate that even in sentence non-initial position salient meanings are not blocked when contextually incompatible, an additional experiment was designed.

3. Experiment 2

Recall that according to the graded salience hypothesis, the lexical mechanism operates obligatorily, regardless of context. Lexical access is an automatic process prompted by a lexical stimulus to search the mental lexicon for its match. Lexical access is exhaustive and ordered: salient meanings are accessed first. Unlike contextual operations, lexical access is not sensitive to sentence position or to any other variable outside the mental lexicon.

Recall further that, as shown in Peleg et al. (2001), contextual effects of highly predictive contexts may occur either prior to the encounter of the lexical stimulus; upon encounter of the lexical stimulus; or post lexically, selecting the appropriate meaning and, at times, suppressing the inappropriate ones (Swinney 1979).

Contrary to expectations, results in Experiment 1 failed to show significant priming for the salient but inappropriate probe when target was presented in final

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position. We suspected that the control condition used in Experiment 1–comparing response time to different probes preceded by the same prime–was not sensitive enough to possible priming effects in final position. Indeed, according to Titone (1998), different kinds of control conditions (different probes) may artificially inflate priming effects. On the other hand, a control condition in which the same probe is used (preceded by different primes, though) may be more accurate.

The purpose of Experiment 2 was therefore to obtain priming effects of ambiguous words presented in final position by using an identical probe for different primes having related or synonymous meanings. We aimed to show that salient but incompatible meanings would not be inhibited even when context is expected to be temporally superior, as at the end of sentences. To do that, sentences ending in compatible but nonambiguous words (*The gardener dug a hole. She inserted the* ***flower***.) were compared with control sentences ending in ambiguous words whose less-salient meaning is contextually compatible (*The gardener dug a hole. She inserted the* ***bulb***.). The probe was identical in each condition, related to the salient but incompatible meaning of the homonym (LIGHT). Comparing the critical homonym (*bulb*) with a control nonambiguous word that was synonymous with the compatible but less-salient meaning of the homonym and, at the same time, semantically unrelated to the salient but incompatible meaning of that homonym (LIGHT) guaranteed that any priming effects related to the salient meaning of the ambiguous prime would be attributable only to the lexical mechanism. However, if context can constrain lexical processing so as to activate the contextually appropriate meaning exclusively (e.g. the "flower" meaning of *bulb*), then there should be no difference between the ambiguous and the nonambiguous control condition. In both cases, the inappropriate meaning (LIGHT) should not be facilitated.

3.1. Method

Design. A simple design was used with only one factor–target word type (ambiguous/nonambiguous).

Participants. Twenty native speakers of English (16 women and 4 men), ranging from 22 to 49 years old, served as paid participants. Most of them were North American teachers of English from Tel Aviv Open University and one was a North American undergraduate student.

Stimuli. Materials were those selected for Experiment 1. The same 24 short passages (taken from Vu et al. 2000, see Appendix B) were used, which featured a target word at the end of a sentence preceded by a strong context, biased toward the less-salient meaning of the ambiguous target word:

(8) The gardener dug a hole. She inserted the bulb.

For each item, we constructed a control passage, which was identical to the target passage except for the target ambiguous word, which was replaced by a nonambiguous but contextually compatible word that matched the compatible, less-salient meaning of the ambiguous word:

(9) The gardener dug a hole. She inserted the flower.

Procedure. As in Experiment 1. Immediately after the target word was displayed, a probe was presented, related to the salient but incompatible meaning of the ambiguous word ("light"). Each participant saw only one condition of each item (ambiguous/nonambiguous target word) selected randomly. Twenty-four additional sentences were created as fillers and were always presented with a non-word probe. The 48 items were arranged randomly and displayed in a different order for each participant. Their presentation and response collection were controlled by a Pentium PC, using a c++ program.

3.2. Results

We averaged the RTs in each condition and compared them, using t-test. As predicted, inappropriate but salient meanings ("light") were activated. This was true for both the subject and item analyses. RTs following the ambiguous target word (mean=993, SD=285) were significantly faster than following the control condition (mean=1070, SD=283), $\underline{t}_1(19) = 3.31$, $p<.005$, $\underline{t}_2(23) = 3.51$, $p<.005$.

3.3. Discussion

Results demonstrate that salient meanings were activated even when they were contextually incompatible and even in a sentential position that benefits contextual processes. Placed in sentence final position, the ambiguous target (*bulb*) facilitated the activation of the probe related to the salient but contextually inappropriate meaning ("light"), while the control target did not. This finding is inconsistent with the predictions of the direct/selective access view. According to the direct access view, the rich prior context in question should have provided sufficient constraints to affect immediate resolution of the (potential) ambiguity involved. The interactive mechanism should have tapped the contextually compatible meaning exclusively, as maintained by Vu et al. (1998, 2000). However, as shown here, this was not the case. Vu et al.'s, findings are, therefore, more compatible with the

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assumption that a strongly biasing context can predict the appropriate meaning very early on without penetrating lexical access that might occur independently somewhat later when the relevant stimulus is encountered (as also indicated by Peleg et al. 2001, Ex. 1).

4. General discussion

Taken together, the results from Experiments 1 and 2 support the graded salience hypothesis and defy the context-sensitive (selective-access) model of ambiguity resolution. They demonstrate that salient meanings were activated even when they were contextually incompatible (Experiment 1–initial position) and even in a sentential position that benefits contextual processes (Experiment 2–final position).

The idea that salient meanings are automatically activated regardless of context have recently gained further support from a series of divided visual field studies conducted in our lab (Peleg and Eviatar 2008ab). Previous studies have suggested that activating contextually appropriate meanings via a predictive mechanism is characteristic of left hemisphere (LH) language processing (e.g. Coulson et al. 2005). In Peleg and Eviatar (2008ab), we therefore examined the unique contribution of the two cerebral hemispheres to ambiguity resolution. Specifically, we examined the activation of salient meanings in the two hemispheres when context is strongly biased towards the less-salient interpretation.

The study was conducted in Hebrew. We used the divided visual field technique in conjunction with a lexical priming paradigm and a lexical decision task. The experimental materials consisted of 112 noun-noun Hebrew homographs that were used as primes–half were homophonic (multiple meanings associated with a single orthographic and phonological representation such as *bank*) and half were heterophonic (a single orthographic representation associated with multiple phonological codes each associated with a different meaning such as *tear*). In order to investigate the influence of meaning salience, we used polarized homographs (words that have highly salient meanings and less-salient ones, such as *bank*). Contextual effects were examined by using three different sentential contexts: an ambiguous context ("He went to the *bank*") a context biased towards the salient meaning ("The businessman entered the *bank*"), and a context biased towards the less-salient meaning ("The fisherman sat on the *bank*"). In order to assess the time-course of ambiguity resolution, we used three different stimulus onset asynchronies (SOAs): 150, 250 or 1000 msec.

Participants were asked to focus on the center of the screen and to silently read sentences that were presented centrally in two stages. First, the sentential context was presented for 1.5 seconds and then the final ambiguous prime was presented

for 150 msec. After the ambiguous prime disappeared from the screen, a target word was presented to the left visual field (LVF/RH) or the right visual field (RVF/LH) for the subject to make a lexical decision. Targets were either related to the salient or the less-salient meaning or unrelated (for a more detailed description see Peleg and Eviatar 2008).

Results indicate that salient meanings were always activated regardless of contextual bias, visual field presentation, or type of homograph. However, the temporal stage at which meanings are activated may vary as a function of SOA, type of context, degree of salience, visual field presentation, or type of homograph.

When the sentential context is kept neutral, salient meanings are activated immediately (at 150 SOA). Activation of less-salient meanings is modulated by SOA, visual field presentation, and type of homograph. In agreement with previous studies (e.g. Burgess and Simpson 1988), in the case of homophonic homographs, both meanings are available immediately (150 SOA) in the RVF/LH, but 100 msec later (250 SOA) only the salient meaning remains active. In the LVF/RH, the less-salient meaning is activated more slowly and remains active for a longer period of time. Alternatively, in the case of heterophonic homographs, it is harder for the LH to activate the less-salient meaning.

When context is biased toward the salient meaning, this meaning is activated exclusively, regardless of SOA, visual-field presentation, or the phonological status of the homograph. Importantly however, when contexts are biased towards the less-salient meaning, the contextually appropriate less-salient meaning and the contextually inappropriate salient meanings are both activated. However, the time course of meaning activation in the two hemispheres is different for the two types of homographs.

In the case of homophonic homographs, both the contextually appropriate less-salient meaning and the contextually inappropriate salient meanings are activated immediately (150-250 SOA) in both hemispheres. Asymmetries are observed only at a longer SOA: Again, in agreement with previous findings (e.g. Faust and Chiarello 1998), 1000 msec after encountering the homograph, the LH selected the contextually appropriate (less-salient) meaning, whereas both meanings were still activated in the RH.

In contrast, heterophonic homographs induce an opposite pattern of results: In the LH, at 150 SOA, only the contextually appropriate less-salient meaning is available. Nevertheless, 100 msec later (at 250 SOA), the salient meaning is activated as well. Thus, at 250 SOA both meanings are available in both cerebral hemispheres. Interestingly, 1000 msec following the onset of ambiguous word, the LH is unable to suppress the dominant contextually inappropriate meaning, while the right hemisphere (RH) is able to do so.

Taken together, these results indicate that salient meanings are always activated, regardless of context. Moreover, even if context is strong enough to

initially activate the less-salient meaning exclusively via a contextual predicative mechanism, salient meanings are still activated via automatic lexical processes as predicted by the graded salience hypothesis.

Overall, our results testify to the involvement in comprehension of distinct mechanisms that do not interact initially, thus enabling comprehenders to resist conformity with contextual information and have a choice. The independence of the encapsulated, exhaustive (lexical) mechanism of contextual processes allows humans an access to meanings not necessarily related to or invited by the information accumulated outside the module. This diversity allows for a deliberation. Indeed, Giora (2003) attests that comprehenders do not always suppress salient but contextually incompatible information (as assumed by Fodor 1983), but occasionally utilize it for various purposes such as humor, pleasure, innovativeness, and subversion (see also Morris and Binder 2001). The existence of a modular mechanism and a set of privileged meanings that resist immediate compliance with contextual information allow the individual an insight into different alternatives.

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Appendix A

Materials (experimental items, probes and comprehension questions) of Experiment 1 (taken from Vu et al. 2000):

1. The gardener dug a hole. She inserted the bulb*.

The gardener dug a hole. The bulb* was inserted.
light
flower
cliff

Did the teacher insert the bulb?

2. The gambler wanted an ace. He searched the deck*.
The gambler wanted an ace. The deck* was searched.
ship
pack
metal

Did the gambler search the deck?

3. The graduate wanted a car. She saved the dough*.
The graduate wanted a car. The dough* was saved.
flour
money
station

Did the graduate sell a car?

4. The hippie changed his appearance. He cut the lock*.
The hippie changed his appearance. The lock* was cut.
key
hair
sheep

Did the hippie change his appearance?

5. The dermatologist examined the skin. She observed the mole*.
The dermatologist examined the skin. The mole* was observed.
rodent
face
church

Did the teacher examine the skin?

6. The guitarist adjusted the string. She changed the note*.
The guitarist adjusted the string. The note* was changed.

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memo
tone
lady

Did the guitarist adjust the string?

7. The singer raised his voice. He changed the pitch*.
The singer raised his voice. The pitch* was changed.
throw
sound
project

Did the singer lower his voice?

8. The headwaiter scanned the list. He recommended the port*.
The headwaiter scanned the list. The port* was recommended.
harbor
wine
servant

Did the headwaiter scan the list?

9. The nurse hated the alarm clock. She modified the ring*.
The nurse hated the alarm clock. The ring* was modified.
diamond
loud
letter

Did the nurse hate the sofa?

10. The maid cleaned the house. She smoothed the spread*.
The maid cleaned the house. The spread* was smoothed.
butter
bed
noise

Did the maid clean the house?

11. The best man rehearsed his lines. He prepared the toast*.
The best man rehearsed his lines. The toast* was prepared.
bread

drink
stereo

Did the woman rehearse her lines?

12. The animal felt an itch. He scratched his trunk*.
The animal felt an itch. His trunk* was scratched.
car
elephant
bullet

Did the animal feel an itch?

13. The cardiologist found the problem. He repaired the vessel*.
The cardiologist found the problem. The vessel* was repaired.
boat
blood
draw

Did the psychologist find the problem?

14. The amateur wanted to win. She needed a spare*.
The amateur wanted to win. A spare* was needed.
tire
strike
body

Did the amateur want to win?

15. The resident noted the broken elevator. She counted the flights*.
The resident noted the broken elevator. The flights* were counted.
plane
stairs
credit

Did the resident note the broken window?

16. The sailor shoveled the sand. He covered the chest*.
The sailor shoveled the sand. The chest* was covered.
body
treasure

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math

Did the sailor shovel the sand?

17. The woodsman was hunting. He observed the game*.
The woodsman was hunting. The game* was observed.
play
animal
coffee

Was the woodsman playing?

18. The barmaid dropped the tray. She broke the glass*.
The barmaid dropped the tray. The glass* was broken.
window
cup
growl

Did the barmaid drop the tray?

19. The zookeeper mixed the grain. He fed the kid*.
The zookeeper mixed the grain. The kid* was fed.
child
goat
maple

Did the farmer mix the grain?

20. The mayor helped the group. He organized the lobby*.
The mayor helped the group. The lobby* was organized.
motel
legislative
stimulation

Did the mayor help the group?

21. The boyscout searched his supplies. He found a match.
The boyscout searched his supplies. A match was found.
together
fire
weight

Did the soldier search his supplies?

22. The tycoon attended the opening. He named the plant*.
The tycoon attended the opening. The plant* was named.
green
factory
harbor

Did the tycoon attend the opening?

23. The boss mailed the invoice. She kept the record*.
The boss mailed the invoice. The record* was kept.
album
organized
Indian

Did the assistant mail the invoice?

24. The agent was ecstatic. He discovered a star*.
The agent was ecstatic. A star* was discovered.
sky
movie
label

Was the agent ecstatic?

Fillers

1. The center awaited the pass. The ball* was watched.
nad

2. The robber rushed out the door. He came from the bank*.
nevir

3. The renter heard the sound. The bark* was investigated.
worg

4. The runner watched the throw. He approached the base*.
enfase

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5. The boy came from the dugout. The bat* was located.
luxab

6. The technician was incompetent. He overlooked the battery*.
inc

7. The therapist entered the room. The cane* was delivered.
lagus

8. The dealer saw the markings. She exchanged the cards*.
gaink

9. The planter sprayed insecticide. The field* was rechecked.
tenibar

10. The wife put up a picture. She bent the nail*.
shipol

11. The scholar knew the reference. The page* was identified.
manatoky

12. The draftsman made a mistake. He examined the ruler*.
douly

13. The professor was grading a speech. The sentence* was heard.
tif

14. The mechanic repaired the car. He switched the shift*.
gink

15. The policeman raised the shield. The shot* was prevented.
liansk

16. The insomniac laid in bed. He noticed the tick*.
hup

17. The groom bought the outfit. The tie* was included.
drack

18. The cashier saw a mistake. He reviewed the charge*.

gepy

19. The appraiser was skeptical. The diamond* was measured.
artek

20. The writer changed the setting. She developed the plot*.
roile

21. The fisherman bought the gear. He showed the net*.
hac

22. The hiker began the journey. The pack* was raised.
vum

23. The suspect saw the police. He burned the pot*.
neer

24. The Buddhist approached the building. The temple* was touched.
yut

Appendix B

Materials of Experiment 2

1. The gardener dug a hole. She inserted the bulb*.
The gardener dug a hole. She inserted the flower*.
light

Did the teacher insert the bulb?

2. The gambler wanted an ace. He searched the deck*.
The gambler wanted an ace. He searched the pack*.
ship

Did the gambler search the deck?

3. The graduate wanted a car. She saved the dough*.
The graduate wanted a car. She saved the money*.
flour

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Did the graduate sell a car?

4. The hippie changed his appearance. He cut the lock*.
The hippie changed his appearance. He cut the hair*.
key

Did the hippie change his appearance?

5. The dermatologist examined the skin. She observed the mole*.
The dermatologist examined the skin. She observed the face*.
rodent

Did the teacher examine the skin?

6. The singer raised his voice. He changed the pitch*.
The singer raised his voice. He changed the sound*.
throw

Did the singer lower his voice?

7. The headwaiter scanned the list. He recommended the port*.
The headwaiter scanned the list. He recommended the wine*.
harbor

Did the headwaiter scan the list?

8. The nurse hated the alarm clock. She modified the ring*.
The nurse hated the alarm clock. She modified the volume*.
diamond

Did the nurse hate the sofa?

9. The maid cleaned the house. She smoothed the spread*.
The maid cleaned the house. She smoothed the blanket*.
butter

Did the maid clean the house?

10. The best man rehearsed his lines. He prepared the toast*.
The best man rehearsed his lines. He prepared the speech*.
bread

Did the woman rehearse her lines?

11. The animal felt an itch. He scratched his trunk*.
The animal felt an itch. He scratched his nose*.
car

Did the animal feel an itch?

12. The cardiologist found the problem. He repaired the vessel*.
The cardiologist found the problem. He repaired the damage*.
boat

Did the psychologist find the problem?

13. The amateur wanted to win. She needed a spare*.
The amateur wanted to win. She needed a strike*.
tire

Did the amateur want to win?

14. The resident noted the broken elevator. She counted the flights*.
The resident noted the broken elevator. She counted the stairs*.
plane

Did the resident note the broken window?

15. The sailor shoveled the sand. He covered the chest*.
The sailor shoveled the sand. He covered the treasure*.
body

Did the sailor shovel the sand?

16. The woodsman was hunting. He observed the game*.
The woodsman was hunting. He observed the animal*.
play

Was the woodsman playing?

17. The barmaid dropped the tray. She broke the glass*.
The barmaid dropped the tray. She broke the cup*.

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window

Did the barmaid drop the tray?

18. The zookeeper mixed the grain. He fed the kid*.
The zookeeper mixed the grain. He fed the goat*.
child

Did the farmer mix the grain?

19. The mayor helped the group. He organized the lobby*.
The mayor helped the group. He organized the people*.
motel

Did the mayor help the group?

20. The boyscout searched his supplies. He found a match*.
The boyscout searched his supplies. He found a knife*.
together

Did the soldier search his supplies?

21. The tycoon attended the opening. He named the plant*.
The tycoon attended the opening. He named the factory*.
green

Did the tycoon attend the opening?

22. The boss mailed the invoice. She kept the record*.
The boss mailed the invoice. She kept the copy*.
album

Did the assistant mail the invoice?

23. The agent was ecstatic. He discovered a star*.
The agent was ecstatic. He discovered an actor*.
sky

Was the agent ecstatic?

24. The guitarist adjusted the string. She changed the note*.

The guitarist adjusted the string. She changed the tone*.
memo

Did the guitarist adjust the string?

Fillers

1. The center awaited the pass. She watched the ball*.
nad

2. The robber rushed out the door. He came from the bank*.
nevir

3. The renter heard the sound. He investigated the bark*.
worg

4. The runner watched the throw. He approached the base*.
enfase

5. The boy came from the dugout. He located the bat*.
luxab

6. The technician was incompetent. He overlooked the battery*.
inck

7. The therapist entered the room. She delivered the cane*
lagus

8. The dealer saw the markings. She exchanged the cards*.
gaink

9. The planter sprayed insecticide. He rechecked the field*.
tenibar

10. The wife put up a picture. She bent the nail*.
shipol

11. The scholar knew the reference. She identified the page*.
manotoky

12. The draftsman made a mistake. He examined the ruler*.

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douly

13. The professor was grading a speech. She heard the sentence*.
tif

14. The mechanic repaired the car. He switched the shift*.
gink

15. The policeman raised the shield. He prevented the shot*.
liansk

16. The insomniac laid in bed. He noticed the tick*.
hup

17. The groom bought the outfit. He included the tie*.
drack

18. The cashier saw a mistake. He reviewed the charge*.
gepy

19. The appraiser was skeptical. She measured the diamond*.
artek

20. The writer changed the setting. She developed the plot*.
roile

21. The fisherman bought the gear. He showed the net*.
hac

22. The hiker began the journey. He raised the pack*.
vum

23. The suspect saw the police. He burned the pot*.
neer

24. The Buddhist approached the building. He touched the temple*.
yut

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