

# Prepositions retain aspects of spatial meaning in abstract contexts

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## Abstract

Prepositions such as *in* and *on* convey not only spatial relationships between objects, but also abstract relationships, such as ‘Mary is *in* love’ and ‘Tim’s *on* a roll’. Although such uses are often thought to be purely idiomatic, we hypothesized that these abstract, non-spatial relationships might preserve one specific aspect of prepositions’ spatial meaning: the degree to which the figure or the ground controls the figure-ground relationship (Coventry, 1992; Coventry, Carmichael & Garrod, 1994; Feist & Gentner, 1997, 1998, 2003). We found that locus of control distinguishes *in* and *on* in common abstract metaphorical contexts (e.g., *in* love/*on* a roll), matched abstract contexts (e.g., *in/on* time), and novel abstract contexts. These findings suggest that prepositions retain aspects of their spatial meaning when used abstractly.

**Keywords:** prepositions; spatial language; semantics; metaphor

## Introduction

Spatial prepositions such as *in* and *on* are often used abstractly to describe non-spatial relationships. For example, we use the same preposition *in* to describe the spatial relationship between two objects, such as ‘an orange *in* a bowl’, and to describe the abstract relationship between a person and an emotional state, such as ‘Mary is *in* love’. Such uses are highly frequent: approximately 40% of preposition use is metaphorical (Steen, Dorst, Herrmann, Kaal, Krennmayr, & Pasma, 2010). The high frequency of these abstract metaphorical uses makes it important to know whether there is some underlying regularity in this usage. Are there patterns of *in* and *on* use that remain stable across spatial and non-spatial contexts?

It is generally assumed that the answer is no: that is, that abstract uses of *in* and *on* are idiomatic and follow no patterns. Intuitively, the abstract uses of *on*, such as ‘*on* a roll’, ‘*on* the way’, or ‘*on* time’ do not seem to have much in common with each other, nor do they form an obvious contrast with abstract uses of *in* such as ‘*in* a fury’, ‘*in* the presentation’, or ‘*in* earnest’. Indeed, the idea that the abstract uses of prepositions are idiosyncratic and lack any regularity is stated quite explicitly in educational materials designed to teach English as a second language. Books designed to teach prepositions to non-native speakers advise students to learn preposition uses on a case-by-case basis. For example, a popular guide to prepositions suggests that abstract uses such as ‘*in* time’ and ‘*on* time’ are entirely

different from spatial uses of these prepositions and must be learned individually (Yates, 1999). Thus, according to the commonly held view, there is no systematic mapping from spatial meanings to abstract meanings for *in* and *on*; abstract uses of these prepositions simply convey frozen, idiomatic meanings.

But perhaps this pessimistic view is premature. After all, there is considerable evidence that spatial language can be used to structure how we talk about more abstract concepts (e.g. Lakoff & Johnson, 1980). For example, spatial terms can be used systematically to describe affective states (Nagy, 1974), such as when we say that someone is feeling *low* or that someone’s spirits *rose*. Spatial terms can also be used to describe communication (e.g., an idea *getting across* to someone) (Reddy, 1979) and to talk about time (e.g., autumn is *ahead* of us or summer is *behind* us) (e.g., Boroditsky, 2000; Clark, 1973; Gentner, Imai, & Boroditsky, 2002; Heine, 1997; Traugott, 1978). Given that spatial terms can often be mapped systematically to abstract domains while retaining many aspects of their spatial meaning, we asked whether the same is true of the prepositions *in* and *on*.

## Factors that distinguish between *in* and *on*

Two factors that have been found to distinguish spatial uses of *in* and *on* in English are geometry and function. Generally, *in* is more likely to be used if the *geometry* of the figure-ground relationship is one of inclusion of the figure in the ground (Miller & Johnson-Laird, 1976; Herskovits, 1986; Cienki, 1989; Bowerman & Pederson, 1992; Coventry, Carmichael, & Garrod, 1994). Additionally, the more concave the ground is (and thus able to contain the figure) the more likely we are to use *in* rather *on* to describe the spatial relationship (Herskovits, 1986; Feist & Gentner, 2003). A second factor that determines whether *in* or *on* will be used is the *function* of the figure and the ground (e.g., Bowerman & Pederson, 1992; Coventry, 1992; Coventry, Carmichael, & Garrod, 1994; Coventry & Garrod, 2004; Coventry & Prat-Sala, 2001; Feist, 2008; Feist & Gentner, 2003; Garrod & Sanford, 1989). For example, *in* is more likely to be used if the ground typically functions as a container for the figure (Coventry, Carmichael, & Garrod, 1994; Coventry & Garrod, 2004; Feist & Gentner, 2003).

While these two factors are very important in distinguishing spatial preposition meaning, it is unclear how

they could transfer to abstract preposition use. Consider the following examples of abstract uses of *in* and *on*:

(1) Sarah is *in* the job market.

(2) Kate is *on* the job market.

Neither of these factors seems to be able to adequately account for the subtle difference in meaning between (1) and (2). The geometry of the figure (a human) and of the ground (an abstract entity) is the same in both examples. It is unclear how the geometry of the relationship between a human figure and an abstract ground could change between (1) and (2). In terms of function, the ground is the same in (1) and (2) and so should be able to function as a container as well in either example. Thus, the factors of geometry and function seem unlikely to distinguish abstract uses of *in* and *on*.

There remains a third factor that distinguishes spatial uses of *in* and *on*—namely, *locus of control* of the spatial relationship between figure and ground. People are more likely to use *in* when the ground object can control the location of the figure, and thus has high control of the figure-ground relationship (e.g., a coin *in* the dish) (Coventry, 1992; Coventry, Carmichael, & Garrod, 1994). Also, because locus of control of the figure-ground relationship tends to reside with the animate member of the relationship, people are more likely to use *in* when the ground is animate—e.g., ‘a coin *in* her hand’—than when it is not—e.g., ‘a coin *in* the dish’. In the other direction, people are more likely to use *on* when the figure is animate (because an animate figure will generally have more control: e.g., ‘a butterfly *on* a dish’ vs. ‘a coin *on* a dish’ (Feist & Gentner, 1997, 1998, 2003).

We hypothesized that, unlike the factors of geometry and function, locus of control might systematically distinguish abstract uses of *in* and *on*. Returning to the contrast between examples (1) and (2), perhaps the difference between someone ‘*in* the job market’ and ‘*on* the job market’ is a difference in the perceived control of the figure over the situation. If *on* tends to convey greater figure control than *in*, then Kate, who is *on* the job market, may be perceived as having greater control over the situation than Sarah, who is *in* the job market. The current experiments used this contrast, among others, to test the importance of locus of control for abstract uses of *in* and *on*.

If locus of control distinguishes abstract uses of *in* and *on*, then we should find that even in abstract contexts, figures *on* ground would be perceived as having more control than figures *in* ground. In the first experiment, this prediction was tested by comparing figure control of conventional metaphorical uses of *in* (e.g., *in* the job market), and *on* (e.g., *on* top of it). According to the view that abstract uses of prepositions have frozen, idiomatic meanings, these common conventional uses of prepositions would be the most likely to have meanings far removed from their spatial meanings. If, however, prepositions retain aspects of their spatial meaning when used abstractly, then *on* should

convey greater figure control than *in* even when used in these ‘stock’ metaphor settings.

## Experiment 1

To test the whether locus of control distinguishes *in* and *on* in conventionalized metaphorical settings, we asked participants to rate how much control figures had over situations described by sentences that either contained a conventional use of a figure *in* ground, a conventional use of a figure *on* ground, or another preposition. We predicted that figures *on* ground would be rated as having greater control than figures *in* ground.

### Method

**Participants** Fourteen undergraduate students from Northwestern University received partial course credit for their participation. All participants were native speakers of English.

**Materials, procedure, design** Participants were presented with 30 sentences, each of which contained a preposition used abstractly. Common abstract uses of prepositions were selected from idiom dictionaries and included conventionalized uses of *in* and *on* (e.g. *in* the way, *on* track) as well as other prepositions. Eleven of the sentences included a figure *in* ground and eleven included a figure *on* ground. Eight sentences included other conventionalized uses of prepositions (e.g. *over* the moon). A corpus search (Corpus of Contemporary American English – COCA) revealed that the figure *in* ground phrases were more than twice as frequent as the figure *on* ground phrases, approximating the natural distribution of these prepositions.

The figure of each sentence was underlined (e.g. Karen is on top of it this afternoon). Participants were asked to read each of the sentences and to rate figure control with a scale ranging from 1 (underlined word is totally controlled by the situation) to 9 (underlined word controls the situation totally), as seen in figure 1, below. The 30 sentences were presented in either a forward or reverse order.

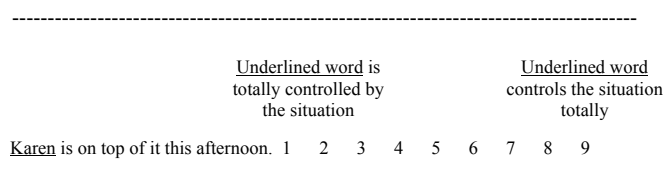


Figure 1: Example of a question asking about figure control of a figure *on* ground.

### Results

In Experiment 1, we tested whether figures *on* ground would be rated as higher in control than figures *in* ground. As predicted, participants rated figures *on* ground as higher

in control ( $M = 6.8$ ) than figures *in* ground ( $M = 5.5$ ),  $t(13) = 4.26$ ,  $p < .001$ .

## Discussion

Experiment 1 tested whether *on* conveys greater figure control than *in* when these prepositions are found in conventional metaphorical contexts. As predicted, figures *on* ground were rated higher as having greater control than figures *in* ground. These findings suggest that locus of control remains important for distinguishing *in* and *on* even in conventional abstract, non-spatial settings.

However, one concern is that the *figure in ground* and *figure on ground* phrases used in Experiment 1 did not use matched grounds. For example, the figure *in* ground phrases included figures *in* love, *in* stitches, and *in* time and figure *on* ground phrases included figures *on* top of it, *on* the way, and *on* a roll. Since phrases were not matched for the ground used, the findings could not rule out the possibility that people associate certain grounds (e.g., *on top of it*) with greater figure control than other grounds (e.g., *in love*). To rule out this possibility, Experiment 2 tested figure control of matched figure-ground pairs. It the locus of control hypothesis is correct, then even with identical grounds, we should find that figures *on* ground (e.g., Mary was there *on* time to the meeting) would be perceived as having greater control than figures *in* ground (e.g., Nancy was there *in* time for the meeting).

## Experiment 2

To test the whether locus of control distinguishes *in* and *on* when placed in matched figure-ground settings, we asked participants to decide which of two figures (the figure *in* ground or the figure *on* ground) had more (or less) control of different situations. In order to equate the figures, we used same-gender proper names for the figures (counterbalancing the particular names across conditions). We predicted that figures *on* ground would be chosen as having more control of the situations, and conversely, that figures *in* ground would be chosen as having less control of the situations.

## Method

**Participants** Twenty-two undergraduate students from Northwestern University received partial course credit for their participation. All were native speakers of English.

**Materials and procedure** Participants were presented with twelve sentence pairs--eight sentence pairs that contrasted the prepositions *in* and *on* and four filler sentence pairs that contrasted other words. Figure *in* ground and figure *on* ground phrases were chosen as in Experiment 1, except that only phrases with matched grounds were included. As before, a corpus search (COCA) revealed that the frequencies of the figure *in* ground and figure *on* ground phrases approximated the natural distributions of these prepositions.

Each sentence pair was followed by a forced-choice question phrased to correspond to the situation described by the sentences. For each of the eight preposition pairs, the forced-choice question was designed to reveal which figure was perceived to have more control. For the four filler pairs, the question concerned which inference about the sentence pair would be more or less likely (e.g. 'Ben and Ted are two miners working in a northern Canadian diamond mine. Workers get a bonus if they are able to find valuable diamonds. Ben found a brilliant diamond. Ted found an opaque diamond. Who is more likely to get the bonus?'). Participants rated their confidence for each forced-choice answer on a 1-5 scale. An example of a preposition sentence pair and forced-choice question is in Figure 2, below:

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Two spies, Agent Taylor and Agent Harris, are both working to complete a secret service operation. The spy who does a better job will be assigned to a more difficult and important project.

Agent Taylor is in the first stage of the operation.	Agent Harris is on the first stage of the operation.
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Who is more likely to be able to finish the operation well?

Agent Taylor	Agent Harris
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How confident are you in the answer you gave?

1	2	3	4	5
not at all confident				very confident

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Figure 2: Example of a preposition sentence pair and forced-choice figure control question.

Participants read each of the twelve sentence pairs and answered the related forced-choice question after each sentence pair. Presentation was counterbalanced so that half of the questions were phrased with *less* and half with *more* (i.e. Who is *less/more* likely to...) and so that predicted answers were associated equally often with the figure *in* and *on* ground and were located equally often on the left and right side of the page.

## Results

In Experiment 2, we tested whether figures *on* ground would be perceived as having more control than figures *in* ground when the prepositions were placed in matched abstract contexts. As predicted, participants made more choices in the expected direction (i.e., choosing the figure *on* ground response when asked about which figure had less control and the figure *in* ground when asked about which figure had less control) than in the other direction,  $p < .005$ , Fisher's exact test. Participants were also more confident in choices made in the expected direction ( $M = 3.81$ ) than the choices they made in the unexpected direction ( $M = 2.99$ ),  $t(21) = 4.83$ ,  $p < .001$ .

## Discussion

Experiment 2 tested whether *on* conveys greater figure control than *in* when these prepositions are placed in matched abstract contexts. As predicted, figures *on* ground were perceived as having greater control than figures *in* ground when contexts were matched. These findings suggest that locus of control can distinguish the prepositions *in* and *on* in matched abstract contexts.

Findings from Experiment 1 suggested that *on* conveys greater figure control than *in* when used in common abstract settings. Because figure *in* ground and figure *on* ground phrases were not matched to include the same grounds, it could not be ruled out that people had memorized which grounds were associated with low versus high figure control. Experiment 2 ruled out this possibility by directly comparing matched figure-ground pairs. Extending the findings of Experiment 1, findings of Experiment 2 further suggest that when used abstractly, *on* conveys greater figure control than *in*.

Both Experiments 1 and 2 used familiar abstract expressions, leaving open the question of whether the extension patterns found here are truly generative. To address this question, Experiment 3 tested matched novel abstract uses of *in* and *on* (e.g., a figure *in* or *on* a cipe). We predicted that locus of control would distinguish *in* and *on* when used in novel abstract contexts: specifically, that figures *on* ground would be perceived as having more control than figures *in* ground.

## Experiment 3

In order to test whether locus of control differentiates novel figures *in* ground and figures *on* ground, in Experiment 3 we asked participants to interpret novel abstract uses of *in* and *on*. Participants were presented with contexts in which novel words could conceivably be used (e.g., in the context of a perfume workshop, a specialty farm, or a community of instrument makers), and were then given a description of a figure from this context either *in* or *on* a novel ground. Participants were then asked to interpret this novel use of the preposition. We predicted that figures *on* ground would be described as having more control of the situation than figures *in* ground.

## Method

**Participants** Sixteen participants received either partial course credit or payment for participation in this experiment. All were native speakers of English.

**Materials and procedure** Participants were presented with 16 situations that involved activities that could be described with a “niche” vocabulary (e.g., perfume making, a specialty farm, historical reenactments). Each situation was described with a paragraph and was followed by a sentence describing a figure from the situation that included a plausible non-word (ARC Nonword Database; Rastle, Harrington, & Coltheart, 2002). Eight of the situations were

described with sentences that included *in* or *on* and eight were described with filler sentences that did not include these prepositions. The orders of the prepositions and non-words were counterbalanced.

An example stimulus, in which a figure is described with a novel abstract use of *in* is presented in Figure 3, below. The participants’ task was to interpret the final sentence describing the figure.

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Context: Kate is a perfume maker who is very skilled at discovering new scent combinations. She works for a perfume company that creates unusual fragrances made from rare plant oils. Kate creates new scents for the company. The process of mixing the plant oils is very complicated. Kate has good days, when the scents she creates are subtle and intricate, and bad days, when her nose seems insensitive and the scents she creates are boring.

Transcript from Tracy (a worker in the perfume company): “It’s the third day of the mixing process and Kate is in a cipe.”

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Figure 3: An example of a novel abstract description of a figure *in* ground.

Two trained undergraduate research assistants read each of the novel situation paragraphs (but not the figure-description sentences) and then read each of the participants’ interpretations of the figure-description sentences. The coders then rated each interpretation for figure control on a scale from 1 (extremely low control of the situation by the person) to 5 (extremely high control of the situation by the person).

## Results

The results of Experiment 3 bear out the hypothesis that novel uses of figures *on* ground would be described as having more control than figures *in* ground. For the example given above, participants who had read that Kate was *in* a cipe gave interpretations such as: “Kate is having problems with her new perfume she’s making” and “Kate isn’t doing so well finding the perfect scent”. Conversely, participants who read that Kate was *on* a cipe gave interpretations such as: “She is creating a good scent today,” and “Kate is doing well. Tracy [another worker at the factory] wishes she were like Kate”.

Across raters, interpretations of figures *on* ground were rated as having more control ( $M = 3.42$ ) than figures *in* ground ( $M = 2.82$ ),  $t(121) = 3.17$ ,  $p < .01$ , with inter-rater reliability of  $r = .677$ ,  $p < .001$ . Mean ratings for figures *in* ground and figures *on* ground are shown in Figure 4, below.

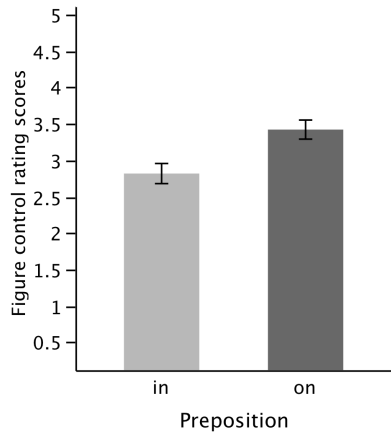


Figure 4: Mean figure control ratings for novel figures *in* ground and figures *on* ground.

## Discussion

Experiment 3 tested whether *on* conveys greater figure control than *in* when placed in novel abstract contexts. As predicted, novel figures *on* ground were described as having more control than novel figures *in* ground. These findings suggest that the locus of control aspect of preposition meaning extends to novel abstract contexts.

## General Discussion

The results of these studies bear out the claim that the prepositions *in* and *on* retain a key aspect of their spatial meaning—namely, locus of control—when used to describe abstract relationships. Experiment 1 tested a variety of highly conventional figure *in* ground and figure *on* ground phrases. We found that figures within conventional *figure on ground* phrases were perceived to have greater control than those within *figure in ground* phrases. We found the same pattern in Experiment 2 with matched figure-ground pairs, ruling out the possibility that people were using learned associations of certain grounds with high figure control and other grounds with low figure control. The findings from Experiment 3 suggest that the locus of control aspect of preposition meaning can also be extended to novel abstract contexts. Together, the findings suggest that one aspect of spatial preposition meaning, locus of control, is retained when these prepositions are used abstractly, both in conventional and novel contexts.

Our results are consistent with prior findings that spatial language can be used to structure non-spatial domains, such as time (e.g. Bennett, 1975; Clark, 1973; Gentner, Imai, & Boroditsky, 2002; Heine, 1997; Lakoff & Johnson, 1980; Traugott, 1978). Recent findings suggest that temporal uses of prepositions (e.g. at noon, on Wednesday, in June) can retain semantic content and influence how speakers think about time (Kranjec, Cardillo, Schmidt, & Chatterjee, 2010).

The career of metaphor hypothesis (Bowdle & Gentner, 1999, 2005) suggests a possible mechanism through which prepositions meanings' could have become abstracted while

retaining aspects of spatial meaning. According to this hypothesis, frequent alignment of a given base term with metaphoric targets can lead to the abstraction of the base's meaning. Thus, for example, if the spatial meaning of *in* is pressed into metaphorical uses such as '*in* my mind' or '*in* a quandary', the resulting common structure will lack a concrete containment relation, but can retain the locus-of-control relation. Over time, this abstraction can come to serve as a secondary meaning of *in*. This more abstract meaning could then be applied across a variety of contexts while still retaining aspects of the spatial meanings. Such an abstraction process is consistent with accounts of the process of grammaticalization by typologists (e.g., Claudi & Heine, 1986).

Although abstract uses of prepositions such as *in* love and *on* a roll are often thought to be idiomatic, the present findings suggest that aspects of these prepositions' spatial meanings are retained in abstract contexts. These findings invite the question of whether other subtle aspects of spatial meaning remain pervasive in seemingly idiomatic usages of spatial language.

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