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Motivation in Mental Accessibility: Relevance of a Representation (ROAR) as a New Framework

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Abstract

The notion of accessibility of mental representations has been invaluable in explaining and predicting human thought and action. Focusing on social cognition, we review the large corpus of data that has accumulated since the first models of mental activation dynamics were outlined. We then outline a framework that we call Relevance of a Representation (or ROAR for short), the main tenant of which is that not all stimulated representations are in fact activated (i.e., influence thought and action processes). More specifically, we propose that the degree to which a representation is available to processes of thought and action is a function of that representation's motivational relevance. We end by demonstrating how the framework enables re-addressing the notions of accessibility, automaticity, and selective attention.

Is it nothing to you, all you who pass by? Lamentations 1:12

When will something in our external environment affect our consequent judgment, thought and action? Over the last two decades in social psychology, we have gathered substantial evidence showing that our thoughts and behaviors can change from exposure to meaningful stimuli even when we are not aware of them. But psychology still lacks a framework for explaining and predicting when this will happen. The goal of this paper is to propose such a framework.

We begin by discussing three important concepts that are central to our framework–mental accessibility, activation, and applicability (for more general reviews of previous research regarding these principles, see Bargh & Chartrand, 2000; Higgins, 1989, 1996; Sedikides & Skowronski, 1991; Wyer & Srull, 1986, 1989).

When initially conceived, accessibility referred to the ease with which a mental representation *could* be activated by external stimulation, and activation meant that a representation *has* been accessed for use (Bruner, 1957a; Higgins, 1996). In other words, a mental representation's accessibility referred to the amount of external stimulation needed for it to shift from a latent state (available in the mind but currently inactive) to an active one (involved in current thought and action). Applicability was conceived to be the degree of featural overlap between a specific mental representation and a specific target stimulus, which contributed to that representation's likelihood of being used (Higgins, 1996). Now that we have established a definitional common ground, we can proceed to selectively review the major findings on the dynamics of mental activation.

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A Brief Review of the Dynamics of Mental Activation

The early years

Much of the empirical knowledge about the interplay between external stimulation and the dynamics of mental representation comes from studies using an experimental methodology called priming (for a review of priming methods, see Bargh & Chartrand, 2000). Priming is understood as temporarily giving an edge to one concept over others by affecting its corresponding mental representation. Studies using priming usually involve: (a) activating a concept by presenting a word, picture or other meaningful stimulus (the prime), either above or below observers' subjective threshold of awareness; (b) making sure that the observers process the stimulus but without giving them any explicit instructions that would suggest a use for the stimulus information; and (c) testing how that concept affects consequent interpretation of stimuli, content of thought, or direction of behavior.

Originating in cognitive psychology and its study of language (Meyer & Schvaneveldt, 1971; Segal, 1967), priming was quickly incorporated into social psychological experimentation (e.g., Higgins, Rholes, & Jones, 1977). Using ostensibly unrelated 'first tasks', people were primed with verbal content that was semantically related to one target concept (e.g., verbal content related to 'persistent' or to 'aggressive') (e.g., Higgins et al., 1977; Srull & Wyer, 1979). These first studies clearly demonstrated that priming of concepts could determine how people will consequently interpret their often-ambiguous social world (for a review see Higgins, 1996; and for a metanalysis of these effects, see DeCoster & Claypool, 2004).

Within social psychology, the first models of the dynamics of representation were constructed to accommodate these findings. In light of the empirical results available at the time, the first models in social psychology emphasized frequency and recency of activation as determinants of whether a stimulated representation would be used in a consequent (ambiguous or vague) situation (e.g., Higgins, Bargh, & Lombardi, 1985; Higgins & Brendl, 1995; Wyer & Srull, 1986, 1989). These models argued that recent or high frequency of past activation influenced future activation by increasing accessibility either transiently or chronically. Applicability was posited to be an additional determinant of whether a stimulated representation will affect interpretation (see Higgins, 1996).

Behavioral outcomes of priming: Challenges to early models

The initial priming studies on person perception were followed by many fascinating demonstrations of priming effects that range from priming concepts like creativity to priming significant others and ideology. Of special interest are the studies exploring the behavioral and motivational effects of priming (referred to as studies on 'nonconscious', 'automatic', or 'implicit' goals and goal pursuit). To take one example, priming the concept of achievement in participants' minds (i.e., exposing them to the words *win*, *strive*, *first*, *achieve*, *succeed*, *attain*, and *master*) led them to perform better than people primed with nonmotivationally related words such as *table* (Bargh, Gollwitzer, Lee-Chai, Barndollar, & Troetschel, 2001, Study 1).

These studies demonstrating behavioral outcomes of priming generated new models that attempted to accommodate this new data. But with regard to underlying processes, these new models did not differ significantly from the earlier models of knowledge activation. All models postulated that the primes activated representations; in the above

example, the representations being people's goals (Bargh et al., 2001). Priming was argued to operate though activating a representation rather than increasing its accessibility per se. The models also specified different kinds of representations – goal representations that differed from purely semantic representations in their ability to control the organism's behavior and/or resources. But generally speaking, these models did not challenge what were thought to be the factors that determined the dynamics of mental representation (cf. Bargh et al., 2001; Kruglanski et al., 2004; but see Morsella & Bargh, in press). Importantly, these models predicted that once a representation was stimulated, it would affect thought and behavior.

However, the adequacy of both the older and newer models of knowledge and goal activation was soon challenged by work suggesting that the effects of concept activation did *not* necessarily have a direct effect on thought and action. New data suggested that stimulation was not sufficient and that the actual activation of a concept depended on its relevance to a person's current and past motivation.

A series of studies by Ferguson and Bargh (2004), for example, found that representations that were relevant to what a person was currently doing or to a person's current needs unintentionally evoked what they initially termed 'positive affect' (see also Ferguson, 2008). Importantly, when the same representations did not have current goal relevance, they did not evoke such 'affect'.

Direct evidence that the effects of priming depended on the motivational value of the primes came from studies that focused on people's pre-existing goals. Ferguson (2007, 2008) demonstrated that people's goal-directed behavior toward being thin or egalitarian depended on the value these concepts had in their minds and that priming the goal modulated the value of goal-related concepts *if the goal itself was important to them*. Similarly, Custers and Aarts (2007) demonstrated that priming words related to 'socializing' influenced people's behavior (i.e., effort allocation), but *only if* socializing was valued by them. Other research shows that this also holds for biological needs as well as goals (Strahan, Spencer, & Zanna, 2002; Study 1; Veltkamp, Aarts, & Custers, 2008a). Finally, another series of studies by Custers and Aarts (2005) suggests that a goal prime does not by default influence behavior. It does so only if it is valued.

All of these findings challenge any modeling of representation dynamics that does not incorporate motivation. They show that the motivational value of a representation mediates between its stimulation and its impact on thought and behavior. This is quite different from the early models in social cognition with their emphasis on cognitive determinants such as recent and frequent activation and applicability.

Beyond priming: Motivational relevance mediates how external stimulation impacts interpretation and judgment

We have reviewed evidence showing that the effects of concept priming on our motivation and behavior depend on the motivational value of the stimulated concept. Now we move beyond goal priming studies to review evidence showing that other effects of stimulating representations depend on their motivational relevance. A study by Smith, Fazio, and Cejka (1996) suggests that motivational relevance may influence not only what one sees but also how one interprets the world. In this study (Smith et al., 1996; Study 3), concepts that were previously categorized to be 'good' or 'bad' were used more rapidly to categorize subsequent objects (i.e., were more active) compared to other concepts that were previously categorized to be 'animate' or 'inanimate' (see also Ferguson, Bargh, & Nayak, 2005).

Possibly linking Smith et al. (1996) results to Ferguson and Bargh's (2004) demonstration of a motivational value 'marker', a study by Kawada, Oettingen, Gollwitzer, and Bargh (2004) suggests that when goal pursuit is obstructed, people tend to project that goal on the behavior of others (see also Aarts, Gollwitzer, & Hassin, 2004; Study 1; Bargh, Green, & Fitzsimons, 2008). Apparently, if goal incompletion or deprivation can assign relevance to goal-related representations (Ferguson & Bargh, 2004), this may lead to greater use (i.e., activation) of these representations in perceiving persons and other objects (Bargh et al., 2008; Smith et al., 1996).

To be clear, the idea that motivational relevance influences interpretation and judgment is not new and harks back to the classic experiments which formed the 'New look' in perception (e.g., Bruner, 1957b; Bruner & Postman, 1948). Recent studies have been more specific, however, and have demonstrated that motivational relevance affects actual perception of ambiguous stimuli (Balcetis & Dunning, 2006), and that both deprivation and experimentally induced value can affect the perception of basic visual properties of motivationally relevant objects, such as their size (Veltkamp, Aarts, & Custers, 2008b). Importantly, the studies by Veltkamp et al. (2008b) are the first to directly demonstrate that stimulation of a representation is not sufficient for it to bias perception– they must also have what we call motivational value. The next section reviews evidence that value determines not only whether a stimulated representation will influence judgment or behavior, but also how long it will do so.

The temporal dynamics of mental representation

We have now briefly reviewed research on the effects of priming on motivation, behavior, interpretation, and judgment, emphasizing the mediating role that motivational value plays in these studies. Generally speaking, the role of value in these studies has not been conceptually related to the dynamics of the representations themselves. We will now highlight research examining the factors that affect how long a representation stays active in mind; significantly, these studies reveal that the dynamics of value markers (a-la Ferguson & Bargh, 2004) and that of activation are strikingly similar.

In an early study, Yaniv and Mayer (1987) showed that words relevant to an uncompleted task remain accessible for a period of over thirty minutes. Echoing Zeigarnik (1927, cited in Baddeley, 1976, p. 269), Yaniv and Mayer (1987) suggested the following: 'perhaps there is an internal monitor of some kind that checks the status of temporarily suspended endeavors and maintains a modicum of extra activation in their memory traces until they have been completed' (p. 200).

More recent studies by Förster, Liberman, and Higgins (2005) demonstrated that the accessibility of goal-relevant representations steadily increase up to some point until the task is completed, at which point accessibility sharply decreases (see also Goschke & Kuhl, 1993), as does the value marker (Ferguson & Bargh, 2004). Förster et al. also demonstrated that goal-related accessibility was affected not only by the (monetary) value associated with the concept but also by its epistemic value– the expectancy of encountering the concept-related target (cf. Bruner, 1957b). Extending these findings beyond 'uncompleted tasks' to biological needs, and again harking back to earlier 'New Look' studies (e.g., Bruner & Goodman, 1947), Berry, Andrade, and May (2007) demonstrated that food-related words were more accessible for food-deprived participants (i.e., a stronger value marker), and that accessibility correlated with the frequency of intrusive thoughts about food.

Finally, recent studies by Aarts, Custers, and Marien (2009) demonstrated that when a specific color was primed up to 20 s earlier, people were more prone to report being the

author of 'making' that specific color appear on the screen, but *only* when it was primed in contingency with positive words (loading it with 'value'). Aarts and colleagues argued that the increased authorship ascription is the result of the longer duration of accessibility of the 'outcomes' (the colors) driven by their experimentally increased motivational value.

Recall that Ferguson and Bargh (2004) demonstrated that mental representations are automatically 'positive' as long as they are motivationally relevant. We can speculate that when these markers are sufficiently strong, they modulate activation to influence thought and action.

Our ROAR Proposal

Taken together, these findings led us to re-think the nature of accessibility and activation of mental representations; more generally, to re-think the dynamics of mental representation. Specifically, we differentiate between three states of mental representations: a *latent* state (available but not stimulated or active), a *stimulated* state (excited but not necessarily active), and an *active* state (functionally available to mental processes). Furthermore, we argue that *motivational relevance* is a primary determinant of whether a stimulated representation is also active and the duration of that activation. And this should be true regardless of the content of that representation (trait, goal, stereotype, or any other kind concept). As long as there is a sufficiently strong signal of relevance, then the activated information will be available to other cognitive processes, such as learning, categorization, planning, and effort allocation, which in turn will impact judgment and behavior. If the relevance signal is weak, the information carried by the activated representation will be unavailable to these cognitive processes and will not impact subsequent judgments and behavior.

Thus, we are proposing that it is *not* some level of activation existing that is then combined with the valence and intensity of the 'affect' (or 'attitude') that determines subsequent responses (cf., Aarts, 2007; Clore & Huntsinger, 2007; Custers & Aarts, 2005; Fazio, 2007; Wilson & Gilbert, 2008). Instead, we are proposing that a signal of relevance of a stimulated representation determines the level of activation *itself*. This is the essence of the framework that we call Relevance of Activated Representations (or ROAR for short).

Because the concept of relevance is central to the postulates of ROAR, we need to begin by stating succinctly what we mean by 'relevance'. In this paper, we apply a recent proposal (Higgins, in press) that motivation may be generally understood as the pursuit of three distinct ways of being effective – effective in *value*, *truth*, and *control*. The lion's share of work reviewed in this paper, reflecting the literature on motivation, has focused on the pursuit of value or *having what's desired* (e.g., a beautiful partner, a fancy car, a tasty sandwich, safety). But there are two other sources of motivation that are also important which have generally received less attention and/or have been undifferentiated from value motivation. One is *truth* motivation – the force behind *establishing what's real*. Another is *control* motivation – the force behind *managing what happens*. It should be noted that normally these three motivations work together in an organization of motives (Higgins, in press).

Thus, in ROAR, a signal of motivational relevance will reflect the degree to which a stimulated representation *serves* one or any combination of these three motivations. When referring to mental representations we will refer to their value, truth, and control relevance. In subsequent sections, we muster additional evidence from outside the social cognitive literature to support the ROAR framework: (a) evidence that the proposed

relevance signal exists and that it is rapid enough to decide the fate of a stimulated representation; (b) additional evidence that activated representations are selected on the basis of their relevance and that irrelevant ones leave little or no cognitive trace; and (c) additional evidence that links motivational relevance to the temporal dynamics of mental representations.

A relevance signal?

Two important questions should be addressed here. First, is there, indeed, evidence that the mind has information on the motivational relevance of a stimulated representation? Second, is such information available within a time scale that enables the mind to gate and maintain activation of a rapidly decaying representation?

Evidence from behavioral and physiological measures has converged to suggest that the answer to the first question is 'Yes'. When representing external stimulation, the mind also represents the motivational relevance of that stimulation (alternatively named 'biological significance', 'affective significance', or 'affective meaning'). Apparently, it also does so very rapidly, suggesting that the answer to the second question is also 'Yes'.

Estimates of the speed of computing the relevance of a stimulus vary and depend on the complexity of the relevance information involved (e.g., 'value', 'relevance', 'arousal', 'valance', or 'feeling'; Cunningham & Zelazo, 2007). Junghofer, Bradley, Elbert, and Lang (2001) demonstrated that unique brain activity for valenced pictures (compared with neutral ones) can be identified as rapidly as 150 ms after stimulus onset (see also Murphy & Zajonc, 1993). This time scale is to be compared with estimates of the time course of (gross) visual identification that range from 50 to 200 ms (e.g., Schendan, Ganis, & Kutas, 1998). Moreover, this finding suggests that it is the representation's value relevance that is rapidly available to the mind, rather than whether it is positive or is negative, as both negative and positive stimuli produce a similar signal.

Additional support for the existence of a value relevance signal that is not just hedonic valence comes from an fMRI study by Cuningham and colleagues (~~2004~~). They found 3
that, while both negatively and positively valenced stimuli activate the amygdala, the activation followed the predicted motivational relevance of those stimuli – in this case their chronic regulatory focus (Higgins, 1997). The amygdala of prevention-focused participants who are concerned with losses and nonlosses responded more to the negatively valenced stimuli that are especially relevant to them, whereas ~~but~~ the amygdala of promotion-focused participants who are concerned with gains and nongains responded more to the positively valanced stimuli that are especially relevant to them.

There is abundant evidence in rodents for a rapid value relevance signal that immediately follows the presentation of a stimulus (for reviews see Berridge & Robinson, 1998, 2003). Interestingly, this same rapid signal (i.e., striatal dopaminergic activity) is argued by others to reflect a learning or expectancy signal as well (Schultz, Dayan, & Montague, 1997), which we would call a signal of *truth* relevance. Still others argue that this signal reflects an unexpected 'having an effect' signal, which in our terms, is an example of a *control* relevance signal (Redgrave, Gurney, & Reynolds, 2008).

Although different views do exist on the nature and sequence of evaluative information that follows the activation of a representation, many researchers agree that these may signal its motivational relevance (e.g., Cunningham & Zelazo, 2007; Fazio, 2001; Ferguson & Bargh, 2002, 2007; Lazarus & Smith, 1988; Robinson, 1998). Considering the rapidness of these signals, it seems safe to conclude that the information regarding the motivational relevance of a representation is available within a time scale that enables the mind to

respond quickly to events based on these signals. For ROAR, it is fast enough to pass or not pass stimulated information to other mental processes on the basis of its relevance.

As a final note, although most current evidence for signals of relevance concerns value relevance, we believe that there are likely to be other, relatively unexplored, types of relevance signals. For example, there could be a control relevance signal that is the product of mental simulation that compares one action's efficiency to the efficiency of alternative actions, or a truth relevance signal that is the product of a comparison between the certainty of one problem solution to the certainty of alternative solutions. Let us now consider the evidence that value, control, and truth relevance select among stimulated representations.

Motivational relevance selects between stimulated representations

Value relevance. Although other models have emphasized the role of positive value relevance (~~cf.~~ Aarts, 2007), ROAR predicts that high negative value relevance, such as threat, should also produce strong activation. For example, Reinecke, Rinck, and Becker (2006)demonstrated that for spider-phobic people, a picture of a spider presented among an array of other objects was recalled better and for a longer duration than any other object (see below for further elaboration). Apparently, for spider-phobic people, the threatening object did leave an enduring trace in the cognitive system ~~and was spared from 'amnesia'~~.

According to ROAR, spiders are highly value relevant (negatively) for spider-phobic people. But while studies focusing on anxiety or fear-provoking stimuli lend some support to this proposal, we recognize that the relations among signals of threat, accessibility, and actual behavior may be more complex than those involving positivity, as Freud (1915) suggested in his notion of repression. For example, when studies with lexical decision and 'Stroop-like' tasks use words related to threats, such as social stimuli for people with social anxiety (Mathews & MacLeod, 1994), responses are slower rather than faster (e.g., Algom, Zakay, Monar, & Chajut, 2009; Estes and Adelman, 2008; see Williams, Mathews, & MacLeod, 1996, for a review). What might be happening here?

While ROAR would predict, at least in a lexical decision task that measures activation, a faster response for threat-related words because of their greater value relevance, we speculate that the expected activation effect could be masked by additional factors occurring at the same time that slow down responses under certain conditions. One such factor could be the generation of a 'freezing response' in the face of threatening stimuli (Algom, Chajut, & Lev, 2004). Storbeck and Clore (2008) suggest yet another possibility that negative mood itself may reduce response speed. From this perspective, a representation with negative value relevance may become more active only to arouse negative *affect* in individuals that slows down their response to *that* stimulus. This conclusion receives support from studies using the 'dot probe' paradigm (MacLeod, Mathews, & Tata, 1986). In this paradigm, participants respond to motivationally irrelevant targets that appear immediately after a threatening stimulus (with high negative value relevance and high negative valance) or a motivationally irrelevant one. Under these conditions, when the target *itself* is not negatively valanced (thus not producing the downstream effects that may slow down RT's), response times are faster following the motivationally relevant threatening stimulus.

Considering the contribution of both positive *and* negative value to relevance, also suggests a possible difference between ROAR and Fazio's influential MODE model (Fazio,

1990). According to the MODE model (Fazio, 2007), if the object (i.e., the mental representation) includes different attributes, the more attitude-evoking possibility – either strong positive good evaluation or strong negative bad evaluation – is at an advantage. ROAR's prediction is different. Because both high negative and high positive value relevance contribute to the overall relevance of a representation, ~~their product is what determines activation. Thus,~~ activation for strong ambivalence should be higher than when only high negative or high positive value exists.

Control relevance. Outside of social cognition, strong evidence for the role of motivational relevance in selection comes from demonstrations of 'cognitive blindness' for presented (but task irrelevant) information, even when it is presented for lengthy durations (see Most, Scholl, Clifford, & Simons, 2005). These phenomena all involve an alteration to a visual scene that occurs in front of perceivers' eyes without them noticing it because it is not relevant to what they are trying to manage to do (control), such as a change in color of a speaker's shirt, the disappearance of a jug of water, or a person in a gorilla costume crossing their visual field (Phillips, 1974; Rensink, O'Regan, & Clark, 1997; Simons & Chabris, 1999; Simons & Levin, 1997). Connecting such failures to notice to Sperling's (1960) demonstrations of iconic memory, Wolfe (1999) posited the 'inattentional amnesia' hypothesis arguing that unattended stimuli (analogous to Sperling's task irrelevant stimuli) rapidly decay without leaving a trace in the cognitive system (i.e., do not influence cognition or behavior). In a more recent series of studies, Wolfe, Reinecke, and Brawn (2006) supplied additional evidence for the rapid decay of visual short-term memory by demonstrating that people were unable to report, seconds after its disappearance, the color, orientation, or identity of a specific stimulus within a larger array. This held even if the full array was viewed by participants many seconds beforehand. (As reviewed earlier, and in contrast to these results, fear-inducing stimuli were spared from this 'amnesia').

A number of findings suggest that no traces of task irrelevant stimuli are detected even if more 'implicit' measures are used. Consider, for example, recent studies using a Stroop-like task (where participants are required to name the color of a focal object), a task that captures processes that are not contingent on awareness or active rehearsal. Using this task, Gronau, Cohen, and Ben-Shakhar (2003, 2009) found that the representations of irrelevant stimuli (the participant's name) were activated only if they appeared in a relevant location, whereas representations of task relevant stimuli (color names) were activated (produced the classic Stroop response) even when they appeared in an irrelevant screen location. These findings demonstrate that task irrelevant representations, if they are not assigned relevance because of appearance in a relevant location, are not activated and are functionally unavailable to mental processes.

In another demonstration of the role of control (or task) relevance in unintentional or 'automatic' processes, Eitam, Hassin, and Schul (2009) found that unintentional learning 6
of relations between stimuli ('implicit learning') depended on the relevance of those stimuli, even though all of the stimuli were presented for a full seven-seconds (see also, Jimenez & Mendez, 1999; Turk-Browne, Junge, & Scholl, 2005). These results support the ROAR framework. Irrelevant stimuli may be stimulated but are not activated, and thus they would be functionally unavailable to the processes that compute environmental regularities.

Truth relevance. Although less common than research on value or control relevance, there is also some research evidence for truth relevance selecting between stimulated representations. It is an established finding in psycholinguistics, for example, that a

representation of an expected word, which is high in truth relevance, will be activated (Hasson & Giora, 2007). Conversely, MacDonald and Just (1989) showed that activation of a negated word (low truth relevance) is lower than when it is affirmed. By examining whether the same term in a sentence does versus does not refer to something that actually exists, Kaup (2001) supplied compelling evidence for the relation between truth relevance and activation. For example, in the sentence *Mary threw out the bread but not the cookies* (destroyed bread), the stimulated representation of 'bread' was *less* activated than in the sentence *Mary makes bread but not cookies* (created bread). According to ROAR, the (destroyed) *bread* referent in the first sentence would be established as less real, less true, than the (created) *bread* in the second sentence, which should weaken its activation. This is what was found.

Variation in continuous accessibility as a function of continuing relevance

When reviewing studies on the dynamics of mental representations, we mentioned a number of studies that focused on factors that influence the maintenance of a representation's accessibility. For example, we described the effect that goal completion has on accessibility. The accessibility of value-relevant concepts steadily increases while the task remains noncompleted, but once the outcome (value) is obtained, the accessibility decreases sharply (e.g., Förster et al., 2005; Goschke & Kuhl, 1993). Förster et al. (2005) also found that the accessibility of the value-relevant concept was affected by two other factors – the monetary value associated with that target, and, interestingly, the likelihood that the concept-related target would be encountered. While the first clearly maps onto value relevance, the expectancy that an event will occur is a second *truth* source of relevance, which is reminiscent of the expectancy effects described in the psycholinguistic literature.

There is also evidence that the rate of decay of goal-relevant representations' activation following goal completion varies as a function of individual differences in motivational orientation. The more that individuals have promotion-focused concerns with accomplishment and gains, the more quickly the goal representation declines in activation following goal completion (Hedberg, 2007), presumably because for promotion-focused individuals the value relevance of the obtained goal rapidly declines. In contrast, the more that individuals have prevention-focused concerns with maintenance and nonlosses, the more slowly the obtained goal representation declines in activation (Hedberg, 2007), presumably because for prevention-focused individuals ~~who want to maintain a satisfactory status quo, the value relevance of the obtained goal is sustained~~.

Putting the Framework to Work: Does It ROAR?

After reviewing evidence supporting the postulates of the ROAR framework, we now consider how ROAR can be applied to shed light on a number of phenomena and concepts in psychology. We begin with the concepts of transient and chronic accessibility.

Re-thinking transient versus chronic accessibility

In many of the studies reviewed earlier, the underlying assumption has been that it is the activation of the relevant representation itself, i.e., the accessibility of a concept that is maintained over time. Applying our ROAR framework, we propose an alternative way

to understand such effects over time. If one considers both the manner in which activation is measured (through response times for categorizing stimuli), and ROAR's postulate that as long as the relevance signal emitted by the representation is high then it will be gated through, then a representation itself need not be actively maintained for it to influence thought and action over time. When a stimulus is encountered, if the relevance of its related concept is still high, the concept will be activated ~~and influences~~ thought and action. For example, if a stimulus related to a representation is repeatedly presented and the relevance of that representation has not declined – or has even increased in relevance from repetition increasing truth relevance – it will produce the appearance of having been continuously actively maintained, i.e., chronic accessibility, because it will continue to influence the judgment or behavior measure.

As reviewed earlier, in the early work on representation dynamics, recent and frequent stimulation were thought to affect the accessibility over time of the representation itself, typically conceptualized in terms of height and persistence of excitation level. But recent and frequent stimulation also relate to the motivational relevance of a representation, such as its truth relevance, and thus would influence the actual (rather than potential) activation of a representation following stimulation. Both repeated and recent priming should lead to an update in the *expectancy* of 'meeting' that stimulus again, with repeated priming establishing a more lingering reality. Because high expectancy has high truth relevance (see Higgins, in press), the stimulus-related representation would have high truth relevance and thus would have more impact on thought and action.

Using our new ROAR-based terminology, we would say that a frequently primed stimulus is *chronically relevant* while a recently primed stimulus is *transiently relevant* when the representation is actually stimulated. This leads us to suggest another differentiation between *situationally specific* (transient) and *cross-situational* (chronic) *relevance* (cf., Higgins & King, 1981). As reviewed earlier, a number of sources may combine to contribute to a representation's relevance. For example, the mechanism underlying phobias or anxiety may be recast as *cross-situational* or chronic relevance of the feared stimuli which thus would be cross-situationally active (when encountered), giving the appearance of chronic accessibility. A similar case can be made for representations that emit a strong cross-situational positive value relevance signal, such as for people who are addicted to drug or alcohol for whom the drug-related paraphernalia emit a strong reward signal (Robinson & Berridge, 1993, 2000). ROAR explains why such a signal would make it very difficult 7 for addicts to put addiction-related representations 'out of their mind' given that their high cross-situational positive value relevance insures that any drug-related stimulus representation would be highly active.

Why are primed representations enacted?

The many behavioral outcomes of priming studies have sparked debates about 'what has been activated' (Bargh, 2006). For example, how can one determine whether it was a representation of a goal or a representation of a behavior that was primed (for a review see Förster, Liberman, & Friedman, 2007)? From the perspective of ROAR, any repre- 8 sentation can be 'motivated', in the sense of having motivational relevance. Representations of knowledge, goals, or actions differ in their current relevance for the organism, and as a result they will differ in the degree and 'longevity' of their effect on thought and behavior.

ROAR embodies a functional reason for why *activated* representations are, by default, handed on to other cognitive systems, thereby increasing the probability that they will

affect behavior and thought. The mind's decision to operate on the basis of activated (i.e., relevant) representations is based on the fact that, according to ROAR, these representations constitute, from past experience, what is thought to produce desired results or (if not handled) undesired results (value relevance), to have helped manage to make things happen (control relevance), and to establish what's real (truth relevance). Indeed, one wonders how people are able *not* to endorse them. In this regard, we are reminded of Donald Hebb's notion of 'self-motivating brain cells' (1955, p. 246): '…any organized process in the brain is a motivated process, inevitably, inescapably; that the human brain is built to be active, and that as long as it is supplied with adequate nutrition will continue to be active. Brain activity is what determines behavior, and so the only behavioral problem becomes that of accounting for *in*activity. [italics in the original]' More generally, this raises the intriguing issue of mental control, which we turn to next.

Re-thinking automaticity: Activation from 'unintentional relevance'

The concept of automaticity is used extensively in psychology (Kihlstrom, 2008; Moors & De Houwer, 2006). Although the concept of 'automatic' in social cognition refers to a combination of features (*lack of awareness, efficiency, unintentionality,* and *uncontrollability*; see Bargh, 1994), it is the feature of unintentionality that has been emphasized in the last decade of research in social cognition. These include racially biased responses (e.g., Devine, 1989), goal pursuits (e.g., Bargh et al., 2001), and political action (e.g., Hassin, Ferguson, Shidlovsky, & Gross, 2007). Many of these demonstrations involved priming of a concept. The assumption was that if people were unaware of the source of their behavior (the prime), then that behavior was unintended (but see Moskowitz & Ignarri, 2009).

Within the ROAR framework, a signal of relevance requires neither conscious intention nor deliberation but is the product of computations of which we are unaware. As such, it is possible for ROAR to suggest a different process underlying so-called unintentional behavior and cognition. Unintentional thought and action may be the product of *activation from unintentional relevance*. Add to this the finding that activated representations tend to be carried out ('doing' and/or 'knowing'), and you have the product of 'automatic' and 'unintended' behavior and thought.

According to ROAR, activation is the product of the organism's internal signal of relevance based on the organism's past history and its current situation. Such a process definition of 'unintentional' processes also marks the limits on whether primes, or more generally external stimulation, will affect behavior. Specifically, it is limited to stimulation that activates representations that have a signal of relevance. If the stimulated concepts of 'polite', 'aggressive', or 'achievement' do not emit a sufficiently strong signal of relevance, then they will not have an observable effect on the person's subsequent responses. This is why subliminal priming is not as powerful an influence tool as people sometimes fear it is (see, for example, Moskowitz & Ignarri, 2009; Strahan et al., 2002).

From the ROAR perspective, the representation is activated and influences subsequent responses *because it is motivationally relevant*. Thus, the common argument that unintended actions following some subliminal priming manipulation demonstrate how people are 'out of control' – doing things despite what they *want* – is overstated. Rather, what plays out in people's responses occurs because the response-related representations are relevant to those people, regardless of whether they are aware of this relevance at the moment. This conceptualization of unintentional action seems to fit well with John Bargh's (1989) notion of 'conditional automaticity' – automaticity that is dependent on the occurrence of some specific set of conditions. ROAR is a significant step in specifying the processes

determining what these conditions are, and it emphasizes the motivational nature of these conditions (i.e., value, truth, and control relevance).

Re-thinking selective attention

The idea that relevance determines activation may explain some of the phenomena that are argued to be a product of selective attention. First, according to ROAR, selective attention is not selection 'out there' (i.e., 'return to the world and collect more data') but rather it operates on the representation themselves through the signal of relevance. Second, ROAR's notion of selection is an activation-based process that is influenced by signals of relevance, which is consistent with the 'unattended amnesia' notion of selective attention (Wolfe, 1999; Wolfe et al., 2006). By this notion, 'unattended stimuli' leave a brief trace but do not come in contact with most cognitive processes. According to ROAR, such fleeting images are the result of low relevance representations, whereas the activation of relevant representations is maintained, enabling them to affect upstream mental processes, such as learning and memory. ROAR extends and develops earlier ideas relating selection and accessibility (Bruner, 1957a; Higgins, 1996) by offering a mechanism: activation is the manifestation of selection, which is driven by the intensity of a relevance signal.

Concluding Comments

Perhaps the loudest roar of ROAR is that the representation's impact on judgment and behavior over time does not derive from the maintenance of the representation's accessibility per se. Instead, the effect on behavior derives from the continuing relevance of the representation. The former notion has typically been understood in terms of priming producing accessibility that then decays at a certain rate as a function of factors like frequency of priming. In contrast, ROAR suggests that changing the motivational relevance of a representation – its value, truth, or control relevance – would alter the likelihood that stimulation of the representation would produce activation with judgmental and behavioral effects, independent of frequent or recent priming per se. For example, variations in current hunger states would produce variations in the activation of food-related representations independent of the frequency or recency of food-related primes. This suggests entirely new ways of changing 'accessibility' by intervening in value, truth, and control relevance rather than frequent or recent priming – new ways that could be directed to everyday issues of too much 'accessibility' (e.g., drug cravings) or too little (e.g., absent-mindedness).

A second loud roar is the introduction of two additional sources of relevance beyond value relevance – truth relevance and control relevance. Consider, for example, Wegner and Erber's (1992) 'hyperaccessibility' of suppressed thoughts and more generally, 'ironic' effects of mental control (Wegner, 1994). They found that when people are instructed to mentally control the activation of some thoughts, these thoughts become *more* rather than less 'accessible'. From a ROAR perspective, what is 'ironic' about this phenomenon is that the task *itself* is to manage the activation of a representation, which thus assigns *control relevance* to that representation, thereby making it *more* likely to be active in mind. And earlier we described Kaup's (2001) finding that the 'accessibility' of a recently primed representation (*bread*) depended on whether its truth relevance was high (the created bread was real) or low (the destroyed bread was not real). This suggests that the 'accessibility' of an object could vary by changing its perceived reality independent of changing

anything about its value. By adding motivation to mental 'accessibility' in this way, ROAR suggests new avenues for future research.

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Short Biographies

Baruch Eitam received his PhD (Summa cum laude) from the Hebrew University in 2009 and is currently a post-doctorate researcher at Columbia University, working mainly with Tory Higgins. From Fall 2011 he will be joining the Psychology Department at Haifa University. He is interested in understanding how we think, behave and change and how motivation interacts with all of the above to affect each other. His most recent publications are on the topic of motivation and implicit learning.

E. Tory Higgins is the Stanley Schachter Professor of Psychology, Professor of Business, and Director of the Motivation Science Center at Columbia (where he also received his PhD in 1973). He is a Fellow of the American Academy of Arts & Sciences. He works at the intersection of motivation and cognition. He is an expert on motivational models of performance, judgment, and decision-making. His most recent research addresses the general question, 'Where does value come from?' His contributions to social cognition, personality, and motivation have been recognized by his receiving a MERIT Award from the National Institute of Mental Health, the Thomas M. Ostrom Award in Social Cognition, the Donald T. Campbell Award for Outstanding Contributions to Social Psychology, and the Lifetime Contribution Award from the International Society for Self & Identity. He has also received the Distinguished Scientist Award from the Society of Experimental Social Psychology, the William James Fellow Award for Distinguished Achievements in Psychological Science (from the American Psychological Society), and the American Psychological Association Award for Distinguished Scientific Contributions.

Endnote

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Q20	**AUTHOR: Roskos-Ewoldsen, & Fazio (1992) has not been cited in the text. Please indicate where it should be cited; or delete from the Reference List.**	
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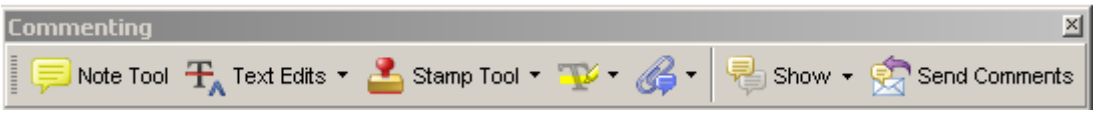
Q22	**AUTHOR: Please provide the page range for reference Wyer, & Srull (1981).**	

USING E-ANNOTATION TOOLS FOR ELECTRONIC PROOF CORRECTION

Required Software

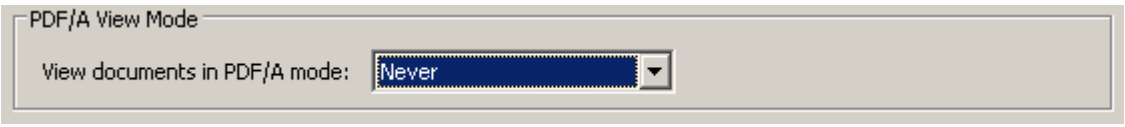
Adobe Acrobat Professional or Acrobat Reader (version 7.0 or above) is required to e-annotate PDFs. Acrobat 8 Reader is a free download: http://www.adobe.com/products/acrobat/readstep2.html

Once you have Acrobat Reader 8 on your PC and open the proof, you will see the Commenting Toolbar (if it does not appear automatically go to Tools>Commenting>Commenting Toolbar). The Commenting Toolbar looks like this:



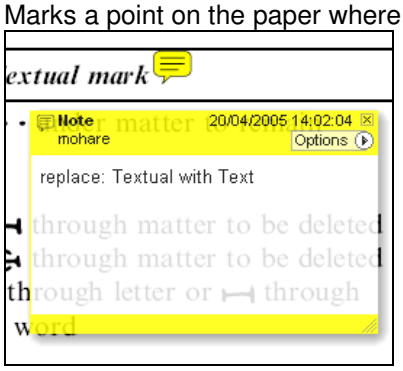
If you experience problems annotating files in Adobe Acrobat Reader 9 then you may need to change a preference setting in order to edit.

In the "Documents" category under "Edit – Preferences", please select the category 'Documents' and change the setting "PDF/A mode:" to "Never".



Note Tool — For making notes at specific points in the text

Marks a point on the paper where a note or question needs to be addressed.

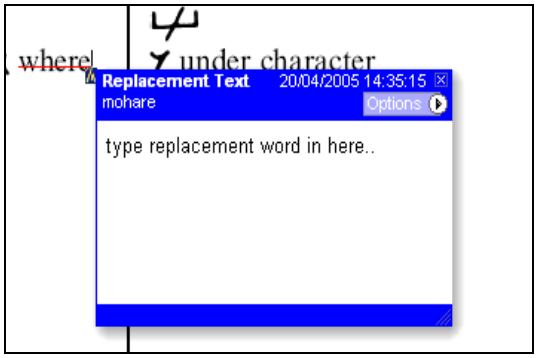


How to use it:

1. Right click into area of either inserted text or relevance to note
2. Select Add Note and a yellow speech bubble symbol and text box will appear
3. Type comment into the text box
4. Click the X in the top right hand corner of the note box to close.

Replacement text tool — For deleting one word/section of text and replacing it

Strikes red line through text and opens up a replacement text box.

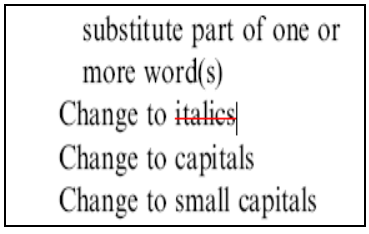


How to use it:

1. Select cursor from toolbar
2. Highlight word or sentence
3. Right click
4. Select Replace Text (Comment) option
5. Type replacement text in blue box
6. Click outside of the blue box to close

Cross out text tool — For deleting text when there is nothing to replace selection

Strikes through text in a red line.



How to use it:

1. Select cursor from toolbar
2. Highlight word or sentence
3. Right click
4. Select Cross Out Text

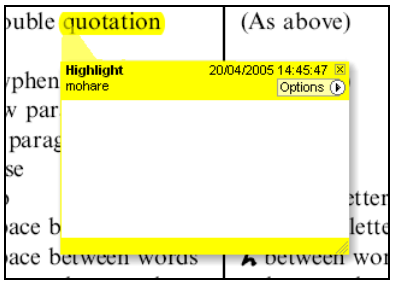
Approved tool — For approving a proof and that no corrections at all are required.

How to use it:

1. Click on the Stamp Tool in the toolbar
2. Select the Approved rubber stamp from the 'standard business' selection
3. Click on the text where you want to rubber stamp to appear (usually first page)

Highlight tool — For highlighting selection that should be changed to bold or italic.

Highlights text in yellow and opens up a text box.

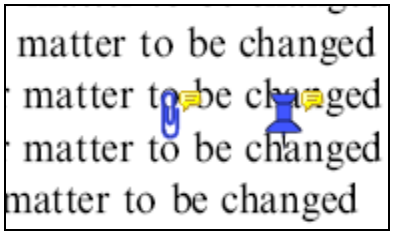


How to use it:

1. Select Highlighter Tool from the commenting toolbar
2. Highlight the desired text
3. Add a note detailing the required change

Attach File Tool — For inserting large amounts of text or replacement figures as a files.

Inserts symbol and speech bubble where a file has been inserted.

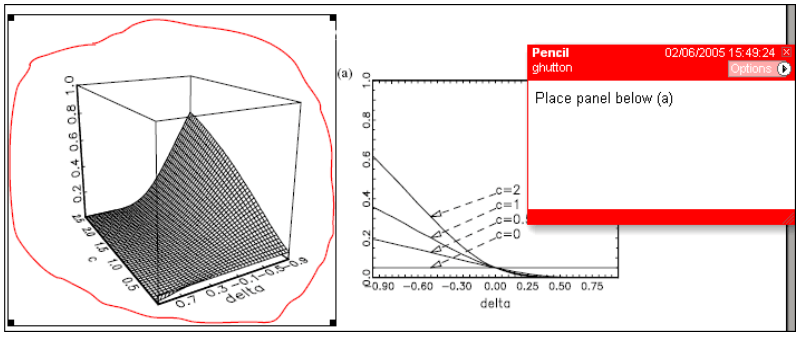


How to use it:

1. Click on paperclip icon in the commenting toolbar
2. Click where you want to insert the attachment
3. Select the saved file from your PC/network
4. Select appearance of icon (paperclip, graph, attachment or tag) and close

Pencil tool — For circling parts of figures or making freeform marks

Creates freeform shapes with a pencil tool. Particularly with graphics within the proof it may be useful to use the Drawing Markups toolbar. These tools allow you to draw circles, lines and comment on these marks.



How to use it:

1. Select Tools > Drawing Markups > Pencil Tool
2. Draw with the cursor
3. Multiple pieces of pencil annotation can be grouped together
4. Once finished, move the cursor over the shape until an arrowhead appears and right click
5. Select Open Pop-Up Note and type in a details of required change
6. Click the X in the top right hand corner of the note box to close.

Help

For further information on how to annotate proofs click on the Help button to activate a list of instructions: