

Meaningful Events in Cognitive and Behavioral Psychology Research Approaches: A 6-Year Literature Review

Eventos Significativos nas Abordagens Cognitiva e Comportamental: Uma Revisão de Literatura de 6 Anos

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Abstract

The concept of meaning has been a traditional object of scientific study over recent decades within the behavioral and cognitive psychology fields. The former defines meaningful events in terms of their existing or acquired behavioral functions. The latter focuses on explanatory models to describe the role of meaningful events in cognitive performance. We performed a literature review of research studies that were published between 2012 and 2017 that investigated the relationship between meaningful events and cognitive processes that are related to language acquisition and behavioral processes, specifically the formation of stimulus equivalence classes. The final sample included 33 articles that were identified by searching three different databases (Web of Science, PsycINFO, and Google Scholar) using specific keywords. The results showed that meaningful events play an important role in cognitive/behavioral processes. More studies were found within the cognitive approach, whereas a stronger effect of meaningful events was observed in studies that employed a behavioral approach.

Keywords: Behavioral psychology, cognitive psychology, meaningful events, meaning.

Resumo

O conceito de significado constitui objeto tradicional de investigação científica há décadas nas abordagens comportamental e cognitiva em psicologia. Na primeira, eventos significativos são definidos como aqueles que possuem ou adquirem uma função comportamental. Já na segunda, priorizam-se modelos explicativos acerca do papel de eventos significativos no desempenho cognitivo. O objetivo desse artigo foi realizar uma revisão de literatura, dentro de um período de 6 anos, sobre estudos publicados entre 2012 e 2017 que investigaram a relação entre eventos significativos e processos cognitivos relacionados à aquisição de linguagem e/ou processos comportamentais, especificamente, formação de classes de estímulos equivalentes. A amostra final consistiu em 33 artigos obtidos por meio de busca em três bases de dados diferentes - Web of Science, PsycINFO e Google Scholar - utilizando-se palavras-chave selecionadas. Os resultados mostraram que eventos significativos desempenham papel relevante em processos cognitivos e/ou comportamentais. Enquanto foi encontrado um número maior de estudos na abordagem cognitiva, observou-se maior efeito atribuído a eventos significativos em estudos na abordagem comportamental.

Palavras-chave: Psicologia comportamental, psicologia cognitiva, eventos significativos, significado.

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Behavioral and cognitive approaches in psychology have devoted much effort to studying what we do and why we do the things that we do. One topic of considerable interest in both fields is the role of meaning in behavioral and cognitive processes.

In cognitive psychology, the meaningfulness of events is defined in terms of variables with measurable dimensions. According to Zdrzilova and Pexman (2013), several theories have sought to explain basic units or dimensions of meaning, among which the authors emphasized those that refer to context, sensorimotor experience, emotion, co-occurrence, and association.

In behavior analysis, meaning has been defined based on variables that acquire control over behavior. Since the analysis of verbal behavior was introduced by Skinner (1957), new developments in behavior analysis have incorporated or combined his view with research on derived relational responding, a branch of behavior research that investigates meaning (Dymond, 2014). Meaning is largely related to language acquisition. Research that employs both cognitive and behavioral approaches has investigated this topic in depth. Here, we adopted the cognitive definition of meaning as one of the variables that account for the processing of verbal materials (Schwanenflugel, 1991). We selected the behavioral description of meaning as a type of symbolic behavior that is observed in the formation of stimulus equivalence classes (Sidman, 1971).

A growing number of studies that use cognitive and behavioral approaches has focused on the enhancing properties of meaning in the learning of symbols and language. Only preliminary data-oriented definitions of this phenomenon can currently be proposed because research on this topic continues to grow.

In the present article, the enhancing properties of meaning refers to variables or dimensions of meaning that account for improvements in performance in either language-learning cognitive tasks or symbolic behavior (i.e., stimulus equivalence) tasks.

Previous studies reported enhancing properties of several dimensions of meaning, such as concreteness (Schwanenflugel, 1991) semantic distinctiveness (Johns et al., 2012), semantic diversity (Johns et al., 2016), and semantic richness (Rabovsky et al., 2012; Recchia & Jones, 2012; Sidhu et al., 2016; Yap et al., 2012, among others. Likewise, studies that use behavioral approaches have shown enhancing properties of meaningful stimuli in improving symbolic behavior performance (e.g., Arntzen & Mensah, 2020; Fields & Arntzen, 2018). According to studies within this branch of research, any stimuli with an acquired history of becoming meaningful may enable derived relational responding.

Both behavioral and cognitive approaches have generated a considerable amount of data on this topic, but some questions remain unanswered. First, within cognitive psychology, many models intend to describe the role of meaning in cognitive processes, but few attempts have been made to integrate them (e.g., Andrews, Frank, & Vigliocco, 2014). Second, studies that use cognitive approaches have reported inconsistent results concerning the role of meaning in cognitive processes, such as word learning (Adlof et al., 2016), visual attention (Hayne et al., 2016), and word processing (Eddington & Tokowicz, 2015). Third, within behavioral psychology, although many studies have reported enhancing properties of meaningful events, the core dimensions that account for their meaningfulness are less understood (Almeida & de Rose, 2015). For example, a study by Fields, Adams, Verhave, and Newman (1993) showed that stimuli that participate in stimulus equivalence classes are not equally related to each other. Similarly, Holth and Arntzen (1998) indicated that familiar stimuli (e.g., pictures) are more effective than unfamiliar stimuli (e.g., Greek/Arabic letters) in producing the formation of stimulus equivalence classes.

Unknown is the extent to which cognitive and behavioral research overlaps with regard to studying the role of meaningful events in human behavior and cognition. To date, no such review articles appear in the literature. Thus, we performed a 6-year literature review of research studies that investigated the relationship between meaningful events and symbolic behavioral/cognitive processes.

We specifically considered two types of studies. The first type of study refers to behavioral articles that focused on enhancing properties of meaningful stimuli, as described by Fields and Arntzen (2018). Progressively more research has investigated the variables that account for the relatedness and enhancement of stimulus equivalence classes (Arntzen & Mensah, 2020). The second type of study refers to cognitive articles that focused on investigating the effects of meaning, understood as semantic properties (Zdrzilova & Penxman, 2013), on cognitive processes that are involved in language learning. Within cognitive psychology, meaning is related to the way in which abstract symbols come to represent events in the real world. Thus, semantic properties of meaning that are addressed in cognitive research may be a suitable counterpart to stimulus equivalence as a behavioral approach to investigating meaning.

Method

The present study performed two types of searches. First, the following search terms, including their derivations, were individually searched in the ISI Web of Knowledge (Web of Science), PsycINFO, and Google Scholar databases:

meaning, meaningful stimulus, cognitive psychology, cognition and meaning, behavioral psychology, symbolic behavior, stimulus meaningfulness, familiar stimulus, stimulus relatedness, stimulus equivalence, and stimulus class. Twenty-one journals were found to have at least one published article about the topic of interest, which were selected and listed in an Excel spreadsheet. We then searched each journal's website using the same search terms. Articles that contained at least one of the search terms either in the title or abstract were selected and entered into another spreadsheet. Lastly, we screened the reference sections of the selected articles to identify additional articles of interest.

The following inclusion criteria were applied: (a) articles published in English, (b) research study that used either a cognitive or behavioral approach, (c) meaning as the primary independent variable and behavioral/cognitive processes as the main dependent variables, and (d) meaning that was investigated in terms of either its role in enhancing the formation of stimulus equivalence classes (i.e., behavior-oriented articles) or its semantic properties (i.e., cognitive-oriented articles). The following exclusion criteria were applied: (a) articles published in other languages, (b) articles that were strictly related to other fields, such as linguistics, neurosciences, phenomenology, social psychology, mathematics, and computer technology, and (c) research study that reported the investigation of meaning in the context of bilingualism, aphasia, other languages (e.g., Spanish and Hebrew), or other psychological phenomena, such as priming, memory, and depression, among others.

Only articles that were published between 2012 and 2017 were selected. This time period was arbitrarily selected for the present 6-year review of studies of meaning that used cognitive and behavioral approaches. The results of each search were checked for duplicate articles, and the final dataset was compiled. Books, book chapters, dissertations, meeting abstracts, and articles that were deemed irrelevant or unrelated to the search terms were excluded.

Results and Discussion

The final sample included 33 articles that were selected for the present study (10 that belonged to behavioral psychology and 23 that belonged to cognitive psychology). The complete list of selected articles is presented in Appendix A. The main results and topic highlights are discussed below according to the following: (1) types of articles, (2) distribution of articles by keyword, (3) number of articles published yearly, (4) number of publication sources and overlapping articles, (5) behavioral and cognitive dependent and independent variables, (6) independent variable effects, and (7) definition of meaning.

With regard to types of articles, the results showed a predominance of empirical research. Interestingly, all of the behavior-oriented papers were in the empirical research category ($n = 10$), and a similar result was found for cognition-oriented papers. Specifically, there was a predominance of empirical research articles ($n = 20$), whereas only two articles were in the theoretical essay category, and one article was in the literature review category.

Unsurprisingly, both approaches strongly relied on empirical data. Empiricism is a shared foundational philosophical principle of both schools of psychology (Pear, 2007; Sternberg & Sternberg, 2012). The data support the argument that they have consistently followed their traditional research directions. Nonetheless, comprehensive knowledge of the state of the art of their scientific production and core principles is also among the main objectives of both disciplines. The results of the present study suggest that they would benefit from increasing the production of articles in categories other than empirical research.

Figure 1 shows the percentage of articles that were found by keyword. Common ground was found between the behavioral and cognitive approaches, in which the keyword "meaning" was most effective in identifying target articles for both approaches. Additionally, we found that the majority of articles were found in two primary sources: Web of Science database and reference sections of the final sample of selected articles.

Although those two schools of psychology have been compared in terms of their differences (Leahey, 2000), the present data indicate that such similarities are worth pursuing further in future studies. Among several reasons for doing so, some authors have argued that searching for similarities would increase the likelihood of effective communication between the two approaches (Proctor & Urcuioli, 2016) and would gradually promote the growth of shared scientific discoveries (de Hower, 2011).

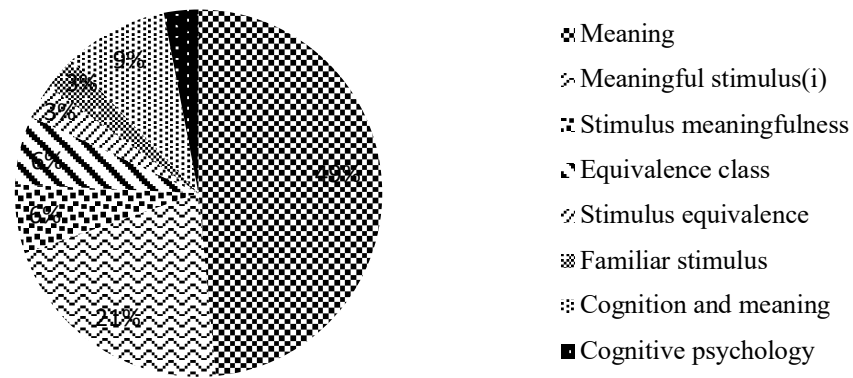


Figure 1. Articles by keyword.

The distribution of published articles by year in both the behavioral and cognitive approaches is shown in Figure 2. The year 2017 had the highest number of published articles within the cognitive approach, whereas 2015 had the highest number of articles within the behavioral approach. Based on the number of articles that were published in each year, we could not identify a definitive pattern in either the cognitive or behavioral approach.

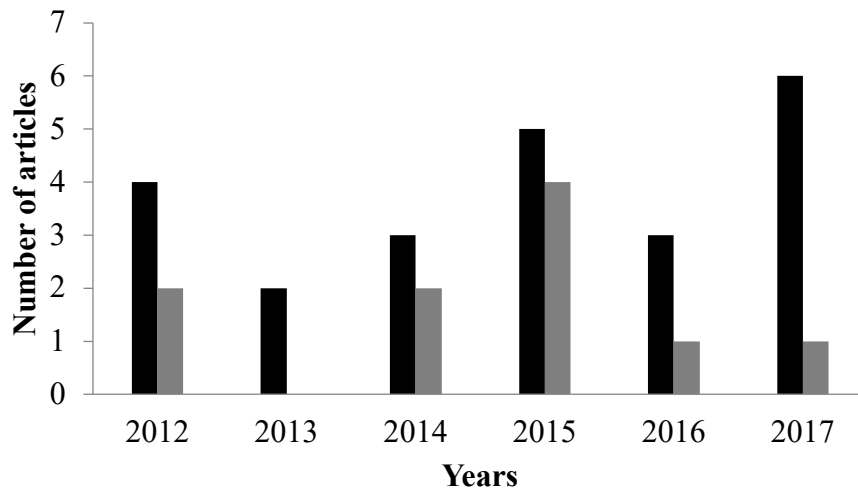


Figure 2. Behavioral and cognitive published articles by year.

With regard to publication sources for the behavioral and cognitive approaches, we found that articles that were published within the behavioral approach were from four leading journals. Within the cognitive approach, the articles were distributed across 13 different journals. This distribution appears to match recent discussion topics in both approaches in two different ways. First, it shows that although behavior analysis researchers have placed effort in broadening the scope of behavioral research (Pietras, Reilly, & Jacobs, 2013), they still strongly rely on behavior-oriented journals as their major publication sources. Second, the emphasis on cross-disciplinary studies of meaning within cognitive psychology (Andrews et al., 2014) is reflected by the diversity of their major publication sources.

Also noteworthy is the fact that there were no overlapping publication sources between the two approaches. Curiously, in their study of the use of behavioral and cognitive terms in published papers, Virues-Ortega and Pear (2015) mentioned that a great deal of research that is performed in cognitive psychology uses behavioral measures, such as percent correct and reaction time. Likewise, traditional cognitive terminology is usually present in the behavioral psychology literature. This suggests that although the two approaches overlap in many respects, this is not reflected in their publication sources.

An analysis of the dependent variables that were studied in the selected articles is summarized in Table 1. A larger number of dependent variables were found within the cognitive approach. Within the behavioral approach, all

but one article investigated the formation of stimulus equivalence classes. The former result may reflect the types of behavioral articles that were selected in the present study.

A summary of independent variables that were found to have a substantial effect on the dependent variables, as measured by statistical tests, is shown in Table 2. With the exception of theoretical essays and single-subject studies, all of the selected articles reported statistical analyses of their results.

Interestingly, the results showed that strong independent-variable effects were reported more often within the selected behavioral papers. Additionally, several approaches to a cognitive understanding of meaning (models) were found, each of them producing both consistent and contradictory results (Devereux et al., 2016; Eddington & Tokowicz, 2015). Importantly, the description of properties of independent variables that account for their meaningfulness varied both within and between the two approaches. Thus, only speculative attempts can be made for such comparisons.

Table 1

Dependent variables studied.

Psychological approach	Dependent variable	No. of articles
Behavioral	Stimulus equivalence class formation	9
	Emergent symmetrical relations	1
Cognitive	Subsequent word learning	1
	Ambiguous word processing	1
	Sentence comprehension	1
	Serial recall	1
	Eye movements	1
	Handedness perspective	1
	Spoken word recognition	1
	Counting	1
	Features of semantic neighbors	1
	Contextual dispersion of semantic neighbors	1
	Learning of verb meaning	1
	Generalization of meaning	1
	Word reading	1
	Word similarity encoding	1
	Processing of abstract words	1
	Visual attention	2
	Learning of new meanings	2
Lexical and semantic decisions	1	
Word recognition	3	

Lastly, the present study evaluated definitions of meaning that were reported in the target articles. In articles that belonged to either of the two psychological approaches, the definition of meaning varied in terms of both complexity and its presence or absence. Although some articles defined meaning by referring to the broad literature within the topic, most of them did so only in the context of specifying the independent variable that was the focus of their study. One difference was notable between the two approaches. Behavioral articles focused on different functions of meaningful events, whereas cognitive articles emphasized existing models to describe meaning.

Table 2
Independent-variable effects.

Psychological approach	Independent variable
Behavioral	Pictures as meaningful stimuli, 6-second delay, discriminative function pretraining, number of pictures, structural location, simultaneous and successive pretraining, conditional pretraining, overtraining
Cognitive	Semantic distinctiveness, semantic diversity, meaning of background speech, semantic richness, semantic relatedness

Accordingly, behavioral definitions of meaningful events tended to be more consistent, whereas cognitive definitions were broader. The results of the present study showed that the two psychological approaches consistently followed their scientific foundations.

The present results showed that the investigation of meaning within the behavioral approach was devoted to finding functional relations between symbolic behavior (i.e., the emergence of stimulus equivalence classes) and meaningful stimuli. In his seminal work, *Verbal Behavior*, Skinner (1957) stated, “meanings are to be found among the independent variables in a functional account, rather than as properties of the dependent variable” (p. 14). The findings of the present study suggest that more than six decades after Skinner’s work, the development of a comprehensive functional description of meaning continues to guide behavioral research in this area.

The present results indicate that cognitive psychology has sought to integrate disciplines to build and test models of meaning. This is consistent with Ulric Neisser’s tradition of describing cognitive processes in terms of models (Neisser, 1977). Neisser relied on computer models as a foundation of cognitive psychology. Recent studies integrated other disciplines, such as psycholinguistics, neurosciences, and statistics, to develop a comprehensive cognitive approach to investigating meaning (Eddington & Tokowicz, 2015).

The study of meaning from the perspective of human language is a strong psychology research topic that relies on both cognitive and behavioral approaches. The description of variables that account for meaning is a common interest within the two approaches. Nonetheless, differences between them arise from the fact that the cognitive approach describes meaning as a product of underlying processes that occur within someone’s mind, whereas the behavioral approach describes meaning in terms of behavioral functions of events that are considered to be meaningful.

Interesting similarities and differences can be found between the behavioral and cognitive approaches in the study of meaning. We highlight the following similarities between the cognitive and behavioral approaches with regard to the study of meaning in the articles that were selected in the present study: (1) a strong focus on empirical research and (2) shared interest in investigating variables that account for meaning.

Among the differences between the cognitive and behavioral approaches, we highlight (1) the higher number of publication sources in the cognitive approach, (2) the focus on cross-disciplinary studies within the cognitive approach as opposed to research within a specific branch within the behavioral approach, (3) the cognitive approach that investigated more dependent variables and a stronger independent variable effect in articles within the behavioral approach, (4) meaning that is described in terms of underlying processes that occur inside the mind in the cognitive approach, and (5) meaning that is defined in terms of behavioral functions of stimuli that are considered meaningful in the behavioral approach.

The present findings reveal a fruitful pathway for future cognitive and behavioral research on meaning, but some limitations should be mentioned. First, many of the target articles that were first found in the Web of Science database were also found in Google Scholar. These were considered double entries rather than included in the final sample. Different combinations of search terms would likely produce different results. Such a caveat was also noted in other studies (e.g., Virues-Ortega & Pear, 2015). Second, the articles that were identified in the present study included only papers that had one of the selected keywords in their title or abstract. This inclusion criterion was applied because of the large number of unrelated papers that were generated by the search. However, some papers within the topic of the present study likely fell out of the final sample when the inclusion criteria were applied.

Finally, we highlight possible directions for future research. First, additional literature reviews should be conducted that include keywords that were not used in the present study, such as semantics, background knowledge, and novelty, to broaden the final sample. Second, the ongoing changes in studies of meaning are themselves deserving topics for future research. Third, we highlight a recent issue in behavior analysis, namely the need to broaden its scope and engage in further cross-disciplinary research. Fourth, an interesting direction of future research in cognitive psychology would be to increase efforts to improve the robustness of different models using powerful research designs. Fifth, we suggest that both the behavioral and cognitive approaches should strengthen their definitions of meaning.

Declaration of conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Contribution of each author

Both the authors are equally responsible for the article contents.

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Appendix A

List of selected articles.

Cognitive Approach			
Journal	Authors	Year of Publication	Title
<i>Cognition</i>	Rabagliati et al.	2017	Representing composed meanings through temporal binding
	Srinivasan et al.	2017	Learning language from within: Children use semantic generalizations to infer word meanings
	Ferguson et al.	2016	What the [beep]? Six-month-olds link novel communicative signals to meaning
<i>Cognitive Science</i>	Stevens et al.	2017	The pursuit of word meanings
	Devereux et al.	2016	Feature statistics modulate the activation of meaning during spoken word processing
	Lazaridou et al.	2017	Multimodal word meaning induction from minimal exposure to natural text
	Silvey et al.	2015	Word meanings evolve to selectively preserve distinctions on salient dimensions
	Kominsky & Keil	2014	Overestimation of knowledge about word meanings: The “misplaced meaning” effect
<i>Memory and Cognition</i>	Jared et al.	2017	Skilled adult readers activate the meanings of high-frequency words using phonology: Evidence from eye tracking
	Rodd et al.	2012	Learning new meanings for old words: effects of semantic relatedness
<i>Journal of Memory and Language</i>	Areshenkoff et al.	2017	Task-dependent motor representations evoked by spatial words: Implications for embodied accounts of word meaning
	Rodd et al.	2016	The impact of recent and long-term experience on access to word meanings: Evidence from large-scale internet-based experiments
<i>Language, Cognition and Neuroscience</i>	Fang et al.	2017	Learning new meanings for known words: biphasic effects of prior knowledge
	de Nooijer et al.	2015	Picturing meaning: An ERP study on the integration of left or right-handed first-person perspective pictures into a sentence context

Review of Meaningful Events

<i>Psychological Review</i>	Räsänen & Rasilo	2015	A joint model of word segmentation and meaning acquisition through cross-situational learning
<i>Current Directions in Psychological Science</i>	Taylor et al.	2015	How word meaning influences word reading
<i>Applied Cognitive Psychology</i>	Ljung et al.	2015	Distraction of counting by the meaning of background speech: Are spatial memory demands a prerequisite?
<i>Cognitive Psychology</i>	Frank & Goodman	2014	Inferring word meanings by assuming that speakers are informative
	Cohn et al.	2012	(Pea)nuts and bolts of visual narrative: Structure and meaning in sequential image comprehension
<i>Topics in Cognitive Science</i>	Andrews et al.	2014	Reconciling embodied and distributional accounts of meaning in language
<i>Journal of Experimental Psychology-Human Perception and Performance</i>	Thornton et al.	2013	The highs and lows of the interaction between word meaning and space
<i>Cognitive Processing</i>	Macizo & Herrera	2013	Do people access meaning when they name banknotes?
<i>Language Learning</i>	Leung & Williams	2012	Constraints on implicit learning of grammatical form-meaning connections
<i>Journal of Experimental Psychology-General</i>	Gillebaart et al.	2012	Mere exposure revisited: The influence of growth versus security cues on evaluations of novel and familiar stimuli
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Behavioral approach			
<i>Learning and Behavior</i>	Nartey et al.	2015	Training order and structural location of meaningful stimuli: Effects on equivalence class formation
<i>European Journal of Behavior Analysis</i>	Hayashi & Vaidya	2017	Effects of stimulus meaningfulness on the acquisition of conditional relations and the emergence of symmetrical relations in adult humans
<i>Journal of Experimental Behavior Analysis</i>	Arntzen et al.	2015	Enhanced equivalence class formation by the delay and relational functions of meaningful stimuli
	Fields et al.	2012	Effects of a meaningful, a discriminative, and a meaningless stimulus on equivalence class formation
	Nedelcu et al.	2015	Arbitrary conditional discriminative functions of meaningful stimuli and enhanced equivalence class formation
	Travis et al.	2014	Discriminative functions and over-training as class-enhancing determinants of meaningful stimuli
<i>Psychological Record</i>	Arntzen et al.	2014	Identity and Delay Functions of Meaningful Stimuli: Enhanced Equivalence Class Formation
	Mensah & Arntzen	2016	Effects of meaningful stimuli contained in different numbers of classes on equivalence class formation
	Bortoloti & de Rose	2012	Equivalent stimuli are more strongly related after training with delayed matching than after simultaneous matching: a study using the Implicit Relational Assessment Procedure (IRAP)
	Almeida & de Rose	2015	Changing the meaningfulness of abstract stimuli by the reorganization of equivalence classes: Effects of delayed matching

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