Theories, Models, and Effects—Oh My! Differentiating Similar Constructs

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Abstract

Theories, models, and effects are related constructs that students often struggle to distinguish. However, these are important psychological tools, and by understanding them and their functions, students will better be able to apply them to psychological phenomena and broaden their depth of knowledge of the field. This article reviews the basic distinction between the constructs and highlights their functions within the field. Generally speaking, theories are broad in scope, offer the best explanatory power, and are generative in nature. Models are moderate in scope and are particularly well suited for prediction and provide clarity of processes. While effects are narrow in scope and are primarily descriptive. Although distinct constructs, there will ultimately be overlap between them. The role of psychology lecturers to teach these constructs to their students is discussed.

Keywords: *theory, model, effect, tools*

Introduction

Theories, models, and effects are related constructs students often struggle to understand. Indeed, when first learning, people often struggle to distinguish between similar constructs (e.g., Kasparian & Steinhauer, 2016), and students can find it difficult to correctly apply or interpret theories (Jonassen, 2008). These difficulties often become evident when psychology lecturers ask students to explain what leads to a particular phenomenon. My own experience with university students suggests errors in responses to such questions often demonstrate a lack of understanding of the nature of theory, employ models instead of theories, or simply describe effects. The following sections highlight distinctions between theories, models, and effects, and why these distinctions are important for students to understand. These constructs are discussed as tools to not only act as learning aids, but to help see their relationship in the scientific process.

Constructs as Tools

Vygotsky (1978) suggested cultural or psychological tools, such as symbols and language, aid thinking. These tools can help people to process information more efficiently, and we tend to learn them from more skilled others. Psychologists use theories, models, and effects as tools to help account for the world. As tools, they accomplish different, though sometimes similar or overlapping, goals. Like physical tools, they need to be appropriately used to maximize their benefit. Using a hammer, for example, to hammer in nails is an efficient use of the tool but using it to cut a piece of wood would do little. Similarly, using an effect to *explain* a phenomenon does not accomplish this goal (though it does give a superficial appearance of providing an explanation); here, a theory would be most appropriate. Students can learn about these psychological tools to help them understand psychological phenomenon, but also to be better prepared to contribute to the scientific process.

What are the differences between these tools? Although it would be nice to be able to give a straightforward answer to this question, this is still debated by philosophers of science (e.g., Suppe, 2000). However, these debates are often more nuanced in nature than need to be communicated to students. The scientific definitions below are given with psychology in mind. They are likely not ideal definitions for all areas in science and are not meant to be representative of how the terms are used in the general population. However, they are given here as a starting point for mutual understanding rather than as definitive definitions.

Theory: A testable explanation of the real world that has generally undergone scientific testing.
Model: A simplified representation of the real world, typically used for prediction.
Effect: A description of an empirical outcome.

Each construct is explicated below including their function within psychological research. This discussion is not an exhaustive one, but a summary of the constructs' relative importance and functions within psychology.

What is a Theory?

In psychology, a theory is typically a broad explanation for psychological processes or outcomes. Theories answer *why* questions. For example, *why* do people seem to copy others? might be explained by social learning theory (Bandura, 1978). Psychologists use scientific theories to explain and understand psychological processes.

Characteristics of Theories

Scientific theories tend to take on certain properties that distinguish them from guesswork or more casual explanations. Anyone can suggest an explanation for something, but scientific theories go beyond this casual explanation and provide one based on empirical evidence. Theories tend to take on several characteristics. What follows is not an exhaustive list of what makes a theory (or what makes it good), but some relevant key properties (for a discussion on some of the key characteristics of scientific theories see Popper, 1963).

Predictive

A theory should be able to make predictions about the real world. It has predictive power if it can make a wide variety of predictions. Theories will vary in their predictive power. Some theories are relatively broad in the specificity of their predictions, while others are quite specific. Predictive power is similar to explanatory power, where a theory can explain a great many things.

Explanatory

Theories explain something. At the initial creation of a theory, these explanations might be relatively untested, but scientific theories are designed to be tested. This is in contrast with common discourse outside of the scientific community, where the word *theory* is often used to imply something is untested or just a guess.

Descriptive

Theories can describe as well as explain. Because theories aim to explain the real world, their descriptions generally aim to be accurate representations of the world. Although theories can be somewhat vague at times, they tend to be highly descriptive on their level of analysis.

Generative

Theories are generative by nature, which is one of their main strengths. For example, in its initial formulation, Terror Management Theory (TMT) (Rosenblatt, Greenberg, Solomon, Pyszczynski, & Lyon, 1989) did not explicitly predict how existential anxiety would influence support or rejection of scientific theories, yet hypotheses along these lines have been derived from TMT and empirically supported (Tracy, Hart, & Martens, 2011). This generative nature of TMT is one of its strengths. Theories that have been around for some time often continue to be generative. Indeed, although the theory of evolution is over 150 years old, new hypotheses are

still being derived from it (e.g., Martens & Rutjens, in prep.), going beyond what the theory was initially proposed to explain.

Scope

A theory is the broadest tool in the psychological explanation landscape. Given how broad theories can be, they can be a challenge to create. This is evident in a quick perusal of work published in scientific journals, which typically relates to theory testing rather than theory creating. Theories are generally broader in scope than both models and effects (see Figure 1). Although broad in comparison to these other constructs, theories can be relatively specific by explaining something in particular, or they can be much broader by explaining a great many things across diverse areas. A particularly broad theory is Darwin's (1875) theory of evolution, which has been applied to diverse areas in biology, psychology, and anthropology, among others. In comparison, reactance theory is a much narrower theory, which attempts to explain how threats to freedom lead to attempts to restore personal freedom (Brehm, 1966). Technically, more limited theories, found at the narrowest level of scope, explaining one finding in particular, are also possible, but such explanations would not always be considered theories. Breadth may be generally preferred for increased predictive and explanatory power, but a theory should not be overly broad as to risk offering an explanation for everything, which would be unscientific and untenable (Popper, 2005).

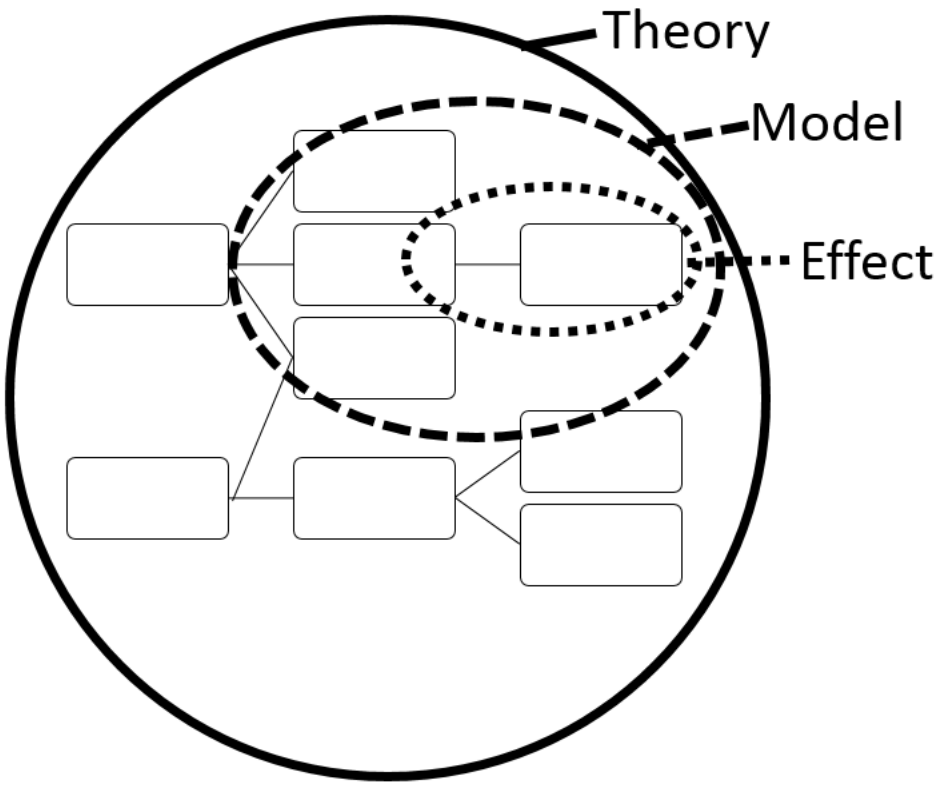

Figure 1. Theories are at the broadest level of scope and effects are the narrowest, with models in-between the two.

Other Properties

Psychological theories are based on empirical evidence since psychology is an empirical science. A theory must explain something in the natural world we can (in one way or another) perceive with our senses. Although mental processes are relatively hidden from psychologists, we can often observe their effects (e.g., behaviour) or use tools to get a glimpse at what is inside the mind (e.g., fMRI). A theory relying on unobservable supernatural phenomenae is not scientific and of little use to psychological research. Theories should also be stated in such a way as to be falsifiable. The theory has to be able to be falsifiable (i.e., proven wrong). Otherwise, it risks being tautological or circular, inherently unscientific (Popper, 2005). Falsifiability is a hallmark of modern science.

Not all theories are created equal. Some are well-supported by empirical evidence, others have mixed support, while others have been rejected by the scientific community because of lack of support. It also is not always clear into which group the theory will ultimately fit. In the early days of phrenology, it was a considered a scientific pursuit with a scientific community made up of science-minded individuals (Rafter, 2005). Today it is considered pseudoscience with little to no support. However, this is a normal process where theories are updated or die out, which can lead to shifts in our views of how the world works (Kuhn, 1962).

As simplifications of the world, however, all theories are necessarily falsifiable. They explain critical aspects thought to contribute to something. Theories cannot exactly describe the effect of every conceivable impacting variable since there will be aspects missing from theories. This might be possible in simple systems, but human psychology is too complex. This is not necessarily a weakness of a theory. Rather, it is part of its purpose. Theories offer explanations people can use to make sense of some aspect of the world. Theories do so in a manageable way. If theories were all-encompassing, they would end up being difficult to even comprehend, let alone use.

What is a Model?

To add to students' confusion, *model* can mean many different things, for example, metaphysical models, pragmatic models, theoretical models, etcetera (Reese & Overton, 1970). *Model* is often clarified in the literature as in which sense it is being used. Given the widespread use of theoretical models in psychology, this will be the focus of subsequent discussions. However, it is important to note other models are also used in psychology (e.g., statistical models). It is, however, the one often confused with a theory. A pure theoretical model is predictive in nature without having an explanation attached to it. With a model, it is possible to enter certain variables and to predict an outcome or effect (see Figure 2). This is evident in the bystander intervention model which delineates when bystanders are, or are not, likely to help a stranger in need during an emergency (Latané & Darley, 1970). Models can be effective without any explanation for why they work, but they are sometimes accompanied by explanations (and thus take on theory-like qualities).

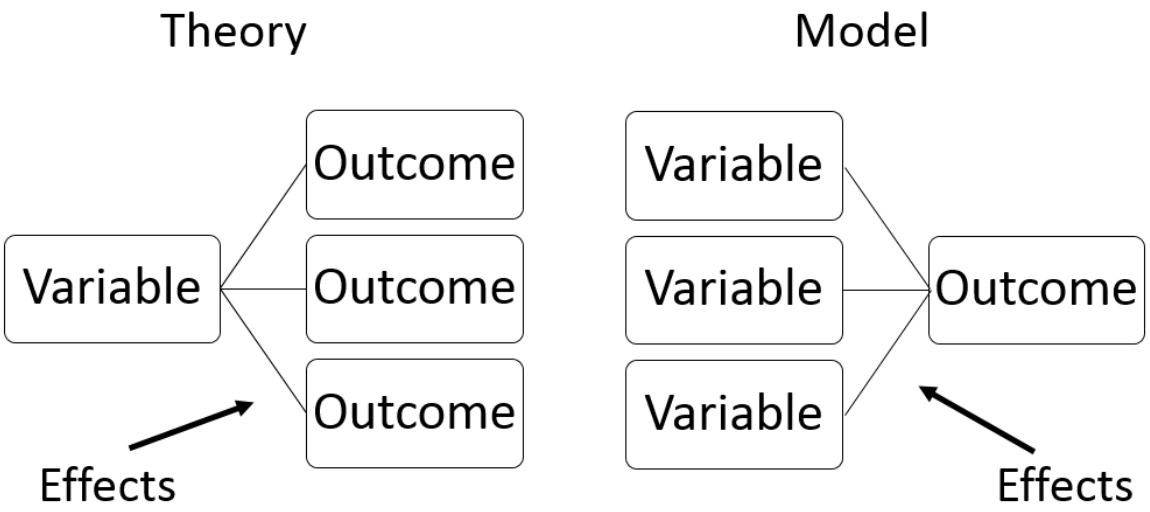

Figure 2. The different nature of theories and models. The left hand panel displays how theories tend to be generative, making predictions about several different outcomes/effects. The right-hand panel shows how models are predictive of a smaller set of outcomes or effects (in this case, one) than are theories.

Characteristics of Models

Predictive

Models are designed to predict a certain effect. As with theories, the level of specificity of predictions can vary, with some models being quite explicit about predictions while others are more general.

Explanatory

Models are generally not explanatory. Although there need not be an explanation associated with them, there are sometimes explanations implied or made explicit in psychological models. When this occurs, models are taking on theory-like qualities. There is not anything inherently wrong when this occurs, but it likely adds to confusion among students.

Descriptive

Models can describe processes leading to outcomes. In this way, they are quite descriptive. However, in principle, it matters little whether or not a model is an accurate representation of the world. Instead, it matters more whether or not it is more or less useful (Reese & Overton, 1970). Consequently, it is possible to have a predictive model of the real world but not descriptive of it.

Generative

Models are typically not generative, although they can be in a limited sense. Models can have somewhat generative qualities if they are applied to areas not initially conceived which might produce a novel prediction. For example, the bystander intervention model was initially conceived as a model to predict helping behaviour in an emergency, but it has also been applied to non-emergency prosocial behaviour such as littering in general (Christensen, 1981). However, this is not the same level of generation produced by theories. Theories are generative by nature; models can be somewhat generative in some cases.

Scope

Generally, models fit within a theoretical framework, making them narrower in scope than theories. However, it is worth noting several theories may to contribute to a single model (see Figure 3). The scope of models has the potential to cause some confusion, as metaphysical models (which are not the subject of this section) can be broader in scope than a given theory.

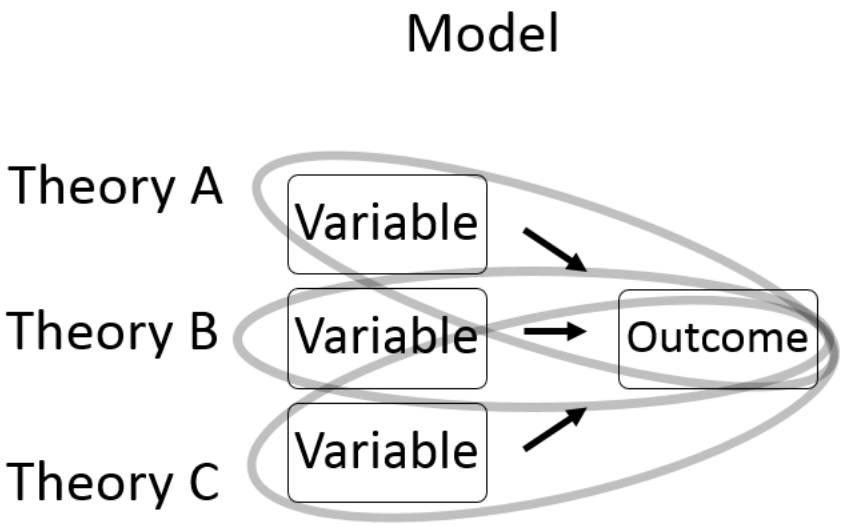

Figure 3. Multiple theories can sometimes contribute to a single model, as is depicted here.

Other Properties

Models lend themselves well to graphs, with boxes and arrows pointing towards different outcomes. There are typically logical rules delineating what happens whether or not certain criteria are met. In the bystander intervention model, a number of decisions are made, each depicted by a box with arrows. For example, if someone does not notice an event the result is irrelevant. Models can be rather complex, but they can typically be visually represented.

Models might be particularly valuable for applied psychology, where what we know about the world is applied to solve real world problems. Although you can apply a theory, utilizing a model is sufficient to accomplish this goal. For example, the key elements of the model in Figure 2 (left hand boxes) should predict the outcome regardless of what the reasons are for this (i.e., there is no need for an explanation from theory). For applied psychology, it

would matter less about why the model works since the primary goal is for the application in the real world and not for understanding.

Similar to theories, psychological models are necessarily a simplification of the world. The most relevant variables are inserted into a model to predict an outcome. However, not every variable that could potentially influence an outcome is included in a model. If it were possible, doing so would create a large cumbersome model difficult to use in any practical sense. Relatedly, the concept of overfitting a statistical model occurs when the model is too complex and begins to account for random error. The model becomes less appropriate with unnecessary added complexity. Models are best when they are relatively simple.

In a general sense, psychological models are somewhat similar to algorithms. An algorithm is a set of rules used to accomplish a goal. Although algorithms generally perform tasks and do not predict outcomes, both models and algorithms follow logical rules to reach an outcome. Models specify the rules and what the outcome should be, while algorithms follow the rules to get to the outcome. Algorithms are not overly useful within the psychological landscape of predicting and explaining psychological processes, but they can be useful for more practical tasks relevant to psychologists, such as identifying faces (Sung & Poggio, 1998).

What is an Effect?

An effect is typically quite specific; it is the consequence of something. A pure effect is entirely descriptive in nature as it simply describes what occurs. Similar to a model, a pure effect has no explanation attached to it. If you were to hold up a pen with your hand and let go, it would fall to the ground. The pen falling to the ground is the effect. A theory of gravity is the explanation for this effect.

Characteristics of an Effect

Predictive

Effects describe an outcome, but this description is also a prediction. In this sense, they are highly prediction. For example, the mere-exposure effect describes how the more exposure you have to a stimulus, the more you tend to like it (Zajonc, 1968). This is also the prediction, the more exposure you have to a stimulus, the more you will like it. However, effects generally do not offer a lot of predictive power. They predict the effect itself and nothing else. In this sense, they are not overly predictive.

Explanatory

There is no explanation offered by an effect. Sometimes researchers attach an explanation, but this is an addition, not the effect itself. Effects are often confused with theories because they can sound like explanations. Someone might ask a budding psychologist, “There were so many people, why did everyone just walk past that stranger who needed help?” and get a response along the lines of, “Well, that’s because of the bystander effect.” This might be somewhat satisfying because it gives a sense of explanation (superficially, it certainly sounds like an explanation), but, in reality, it offers very little as an explanation. What is instead offered,

is a description of what occurred, or to put it another way, the response is a repetition with different sounding words. The bystander effect describes the outcome about which the individual is asking. The effect does not explain the outcome; it is the description of the outcome.

Descriptive

Effects are highly descriptive. This is the main purpose of effects (i.e., to describe something happens).

Generative

Effects typically are not generative but applying effects to new areas is a type of generation. This is a very minimal type of generation in comparison to what theories can accomplish.

Scope

Effects are at the narrowest scope. They are specific in what they are describing. Effects might apply to broad areas, but they are at the narrow end of the continuum. This is not a weakness. Adequately describing an outcome is essential for communication and scientific progress.

Other Properties

Effects might sound like the weakest of the constructs discussed here. A theory works well at explaining, a model is good at predictions, but what precisely is an effect useful for? Effects are important for several reasons. One is because they are descriptive. Being able to accurately describe a real-world phenomenon is a useful thing. It gives the phenomenon life and can promote further research. Theories and models are essentially built to explain and predict effects. Effects are the outcome, the thing in which psychologists are often most interested. So, although effects might not seem to be the most useful tool on the surface, they are an essential one.

When to Use Each?

Theories, models, and effects are best used to accomplish particular goals. Because it is worthwhile for students' education to clearly identify when each is most appropriate to use, this is discussed in the following sections.

When to Use a Theory?

Theories are best employed when you want an explanation. Models are not appropriate here because they do not inherently offer explanations, but a well-developed model takes on theory-like explanatory qualities might be appropriate. An effect is not appropriate here because it has no explanatory power. Theories are also descriptive, so they work well at describing phenomena, though not as specifically as effects. In addition, theories are useful for making

predictions and generating new ideas. When any of these are your goal (e.g., explanation, prediction, etc.), a theory is a good tool for the job.

When to Use a Model?

Models are best employed when you want to predict an outcome and are not overly concerned with explaining it. A theory might also predict an outcome, so it can be utilized for the same goal, but models are more explicitly geared towards predictions so are narrower in scope than theories. For example, although a broad theory can explain and predict stereotype threat, Schmader, Johns and Forbes' (2008) model of stereotype threat not only makes predictions, but visually highlights the key factors and adds clarity to the processes involved. In this way, models are not only good for predictions, but also for clarifying processes.

When to Use an Effect?

Effects are best employed when you want to describe a specific phenomenon. They work well for things that are narrow in scope (i.e., a specific phenomenon). For example, the bystander effect describes how the more people present, the less likely a bystander will intervene to help a stranger in distress. Theories and models can be used to explain and/or predict an effect, but the first step is in describing it.

Additional Points of Confusion

Given theories encompass models and effects (see Figure 1 &Table 1), a student might wonder why we do not simply abandon these other constructs and solely use theory for our endeavours. Such a conclusion would miss the point of these tools. These tools cover different landscapes and are better suited for their respective ones. If you raise your hand holding a pen and drop it, the pen will fall to the ground. This is the effect. It would be quite cumbersome to discuss it in terms of the general theory of relativity (Einstein, 1916). The descriptive nature of effects is what they are good at.

Table 1: Basic comparisons between theories, models, and effects

	Theory	**Model**	**Effect**
Predictive	Moderate to High	Moderate to High	Low to High
Explanatory	Yes	Maybe	No
Descriptive	High	Low to High	High
Generative	High	Low	None to Low
Scope	Broad	Moderate	Narrow

Similarly, although a broad theory of prosocial behaviour may predict a specific helping behaviour, the language of theories is not always ideal for such a task. Instead, a model might be preferred as the language is more conducive to specific predictions. Models might be particularly preferred when one is less interested in explanations and more interested in predictions. Models have the added benefit of clarifying what theories say by explicitly specifying, often visually, key variables. In these ways, models are quite useful.

In practice, psychologists often blur the lines between theories, models, and effects (see Figure 4). Theories can take on model-like properties, models can take on theory-like properties, and effects can start to sound like theories or models. There is nothing inherently wrong with this blurring of lines, but it possibly confusing for students.

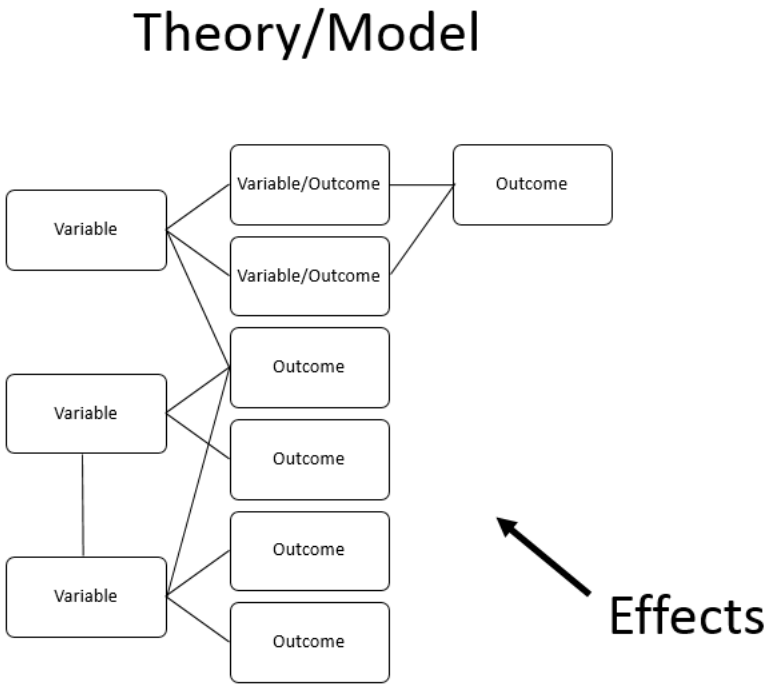

Figure 4. A more complicated view of the interrelationships between theories, models, and outcomes (i.e., effects), which can make it challenging to distinguish the constructs.

Additionally, these terms are sometimes misused in practice. For example, the Identity-Based Meaning Maintenance *Model* (Zhu, Martens, & Aquino, 2012) is clearly more of a theory than a model, so it would be more accurately labelled as the Identity-Based Meaning Maintenance *Theory*. Other labels might also be given for the same thing. There are different sounding labels for effect. For example, the mere-exposure *effect* is often called the familiarity *principle*, and to add to the poor student's confusion, the mere-exposure effect has been used to explain the familiarity principle (Zajonc, 2001). Briefly, to clarify, a principle is typically defined as a well-established fact, so *principle* and *effect* can be used somewhat interchangeably when the effect has considerable empirical support. We might also define subsets of effects. For example, biases might be a particular type of effect. The literature can be a confusing place for a psychology student, which is all the more reason to teach a firm understanding of these concepts so they can make educated judgements themselves.

Other Similar Concepts

Theories, models, and effects tools are part of a larger toolbox. Additional related tools include hypothesis and psychological construct.

Hypothesis: A testable explanation that has typically not undergone the rigors of scientific testing. Hypotheses are specific predictions; a testable statement. An easy way to think of them is as educated guesses. Hypotheses are created and then tested empirically. They are often confused with theories. The most basic distinction between the two is hypotheses are untested or relatively untested, while theories generally have more empirical support and are often broader. In common discourse, theory and hypothesis might be used interchangeably as a guess for how the world works, but this is not how they are used in science.

Psychological construct: A term given to a concept not directly observable to aid in its understanding. Psychological constructs are essentially placeholders. They are not something physically existing but their existence, in our mind, makes discourse much easier. Intelligence is a construct. We can understand what it means, we can discuss it, but we cannot directly observe it. It would be impossible to have a theory of intelligence without the construct of intelligence. Constructs are necessary in psychology and are prevalent in theories, models, and effects. Indeed, theories, models, and effects are all constructs themselves.

Clarifying Student Confusion

Although it appears no specific research has assessed how best to teach the distinctions between theories, models, and effects in psychology, extant research does allow for some speculation on what will likely work. Those in a learning motivation tend to look towards more knowledgeable others when learning (Martens & Tracy, 2013). As lecturers are in a position of authority based on knowledge and students are presumably somewhat motivated to learn, lecturers are in an ideal position to teach the distinctions during class time. This can occur at a basic level, where lecturers simply discuss the topic during a lecture or seminar. However, a flipped learning approach could be employed where students essentially act as peer instructors (Crouch & Mazur, 2001). How this is implemented can vary, but on a basic level, students would be given some pre-reading on the topic, then during class time a more in-depth discussion involving peer interaction would occur. For example, a summary of the distinction (e.g., one created by the instructor or possibly this manuscript) would be assigned to students as pre-reading. During class time, students could then take part in a task where they read about particular theories, models, and effects in extant literature and then correctly identify them. This can be done in a small group setting where discussion occurs and justifications for their answers are provided. The results of this task could also be used to assess progress. This type of teaching method has been shown to be quite effective in the sciences (e.g., Crouch & Mazur, 2001), so it has potential to be effective in this context.

Without empirically testing these approaches to theories, models, and effects, it remains an open question as to how well they may work, but extant research is rather promising, and can serve as a starting point for educators. Still, this remains an area for future research.

Conclusion

Similar to how a carpenter needs to know how to use his/her tools, psychology students should be able to use the tools of the trade. Being able to create, advance, and apply theories and models is a valuable skill and contributes to the scientific process, as is identifying effects.

Theory creation can advance our understanding, models can clarify our thinking, and appropriately identifying an effect can make it real and a topic of study.

It would be odd not to train a carpenter in how to use his/her tools. Likewise, it would be odd not to train psychology students in these concepts. Vygotsky (1978) suggested we learn psychological tools from more skilled others. He called these more skilled people the more knowledgeable other (MKO) and considered them important social models that transmit cultural knowledge. Lecturers in psychology are in an ideal position to act as MKOs transmitting understandings of theories, models and effects to their students, expanding students' psychological toolboxes.

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