The task-oriented approach in psychology: a solution to Fodor's problem

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Abstract

It is proposed that studying individual tasks in isolation is a solution to Fodor's problem: how can we break down the empirical project in psychology into tractable units? The task-oriented approach is in this sense an alternative to the modular view of the mind. I propose a definition of a task as a researcher-defined unit of study that corresponds to a reconfiguration of resources in an animal-enviroment system; this reconfiguration: is meaningful to a perceiver-actor; is amenable to precise characterization; specifies criteria for succesful completion of the task; and provides a guide to researchers on how to generalize empirical conclusions drawn from the study of a given phenomenon. The task-oriented approach is well-suited to the study of certain phenomena that the standard brain-oriented approach struggles to characterize, such as collaborative activity. Framing the dichotomy between the approaches in terms of methodology allows us to avoid fruitless ontological discussions about external content.

Keywords: Tasks; modularity; ecological psychology.

Introduction

Jerry Fodor's essay *The Modularity of Mind* (1983) was an attempt to address a major problem in cognitive psychology: if the aim of the research programme is to come up with an account of how the brain works, then the problem space is impossibly large: where does one start? What's needed is some means of breaking down the overall problem into manageable pieces. Fodor believed that the only plausible means we had of dividing the problem space in a useful way was to endorse some version of faculty psychology: the old idea that the brain is by nature divided into special-purpose units, which on Fodor's account are 'modules'—encapsulated computational devices that interact with one another but otherwise behave autonomously. If the brain is organized into modules this is good news because it means we don't have to study the entire brain, we can start by studying individual modules in isolation: 'The condition for successful science... is that nature should have joints to carve it at: relatively simple subsystems which can be artificially isolated and which behave, in isolation, in something like the way that they behave *in situ*. Modules satisfy this condition...' Fodor argued that the best candidates for modular processes are input-analysing systems such as vision and language, which were held to function inferentially, turning noisy and impoverished sense data into symbols which can be computed over, and which can be fed into central cognitive processes such as thought and memory (which are not themselves modular in nature).

An alternative approach in psychology rejects the rationalist assumptions of Fodor's brand of cognitivism.[1] The ecological realist framework (Gibson, 1979; Michaels & Carello, 1981) does not subscribe to the idea that the job description of the brain is to maintain an internal record of the world. Instead, perception is held to be direct (that is, not mediated by mental symbols) and inextricably bound up with behaviour. Perceiving and acting are held to be a single phenomenon: perception-action. This perception-action process can be conceived as a relation that links an actively exploring animal to its environment—an environment which is itself richly structured and inherently meaningful to the animal by virtue of the things it affords to that animal. The ecological realist is thus not in the business of attempting to give an account of how the brain works. The brain is not the object of inquiry. Rather the ecological project aims to give an account of an animal-environment system: the whole system comprising the animal in its environment.

But a similar problem arises: where to begin? Again what's needed is a way of breaking down the broader project into tractable research problems. The solution that ecological psychologists have settled upon is not to break down the system into component pieces, but to break down the things the system does into individual units. The solution is to study individual *tasks*.

This raises the question: what is a task? It will be argued that there are two quite different ways of answering this question, which correspond to the two types of psychology just identified. The cognitivist, or brain-oriented psychologist is quite familiar with the task as a research device. These tasks are usually carefully constructed laboratory-based activities which seek to measure some behavioural response to a set of stimulus materials. The task is devised as a means of indirectly measuring some aspect of the brain.

The ecological or task-oriented psychologist, by contrast, aims to study real phenomena: activities that people actually engage in outside the laboratory. A prerequisite for being able to study a task in this way is that the task itself can be defined in a precise manner. The phenomena that have been studied most extensively by ecologically-inclined psychologists are simple action-control phenomena; for example: how does a driver control steering, how do infants learn to walk, how does a baseball fielder run to the correct position to intercept a ball in flight? All of these might be considered as tasks in some sense, although it is not equally clear in each case where we should place the boundaries separating the task from other background activity. The baseball outfielder problem is neat in that it has clear start and end points, and a clear criterion for successful performance: the catcher consistently ends up in the right place to intercept the ball. But where does an individual steering task end? And when is the task of learning

[1]Note: this paper will not argue that the concept of modularity lacks merit; rather, the aim here is to establish that there is an alternative approach, and that this alternative is genuinely different and not merely a rediscription of modularity.

to walk complete, if ever?

The present paper has two aims: 1) to achieve precision about the concept of a task, around which some ambiguity exists; in particular I will pursue a definition of the concept that will allow us to expand the scope of the ecological research programme beyond simple visually-guided phenomena like the outfielder problem, but without losing the rigour and precision that such activities impose; and 2) to argue that the task, when defined in an appropriately precise way, is a unit that satisfies the criteria for a solution to Fodor's problem: how can the overall research project be broken down into manageable pieces?

The task as an epistemological device

The first question we must address concerns what nature of thing a task is: which category should we place it in? Should the task be considered a part of reality, or a part of our description of reality? Is the task a thing that resides somewhere in the system, or is it a tool for describing that system in some way?

Within the rationalist framework, a case could be made for either response. Within the ecological framework however, only the latter response makes sense. This can be seen if we try to apply the concept of a task to a specific activity; say, kicking a ball. On the traditional, internalist view, one might be tempted to say that the task is something that resides inside the actor. In order to be able to engage in the activity of kicking a ball, the actor must on some level be able to categorize what they are doing *as* an act of kicking a ball. And further, in order for a particular action to count as an act of kicking, the actor must initially *intend* to carry out that particular action. On this view, the task is perhaps construed as an internal plan or recipe which exists in the actor's head prior to the carrying out of the action: it is a part of reality, and not just of the description.

This rationalist manner of construing the concept of a task is subject to the same criticism as was made by Gilbert Ryle (1949) in relation to the concept of 'volitions'. If a task is an internal entity, how might one go about individuating separate instances? If tasks are real, discoverable things, then it should be possible to answer such questions as the following: 'What was the last task you completed?' 'Of the tasks you have fulfilled today, which took the longest?' 'How many tasks must be performed in preparing a French onion soup?' And then there is the problem of how a particular task or plan is selected. If the actor, in performing some task, must first select a particular method for performing it, this is an internal act of choosing which appears to constitute a task in itself: the task of selecting the next task. But then this selecting task must itself have been selected somehow. The whole thing is thus threatened by an infinite regress. A possible escape, for the internalist, is to say that the actor does not choose the task, but merely acts out whatever script is currently presenting itself. But this implies that the actor must be an automaton—a perennially unpopular proposition.

Within the ecological framework, by contrast, there can be no recourse to positing internal entities. The system is the animal in its environment. In the ball-kicking example, the system consists minimally of an actor and a ball and a perception-action relation linking the two. There is nothing in this system that we can label as the task. Perhaps the relation itself is the task? This might work for a system with only two entities and one relation, but now suppose the actor is kicking the ball at a tree. There are now at least three relations in the system (linking actor and ball, actor and tree, and ball and tree), none of which we could point to individually and label as *the* task.[2]

We are left with the conclusion that the task does not name some component of the system but rather identifies a particular way of looking at the system from the outside. The task is an epistemological device. Some happy consequences follow from adopting this position. It means that we do not have to worry about how to correctly individuate particular instances of tasks: there is no correct way because there isn't anything out there to individuate to begin with. Instead, we can define a task in whatever way is convenient for some purpose.

But as we saw above with the examples of catching a ball and learning to walk, there is much diversity in the things that can potentially be labelled as tasks. The problem is how to define the concept of a task in a useful way, in a way that can be applied quite generally, and in a way which allows us to draw useful conclusions from the particular phenomenon under investigation.

The acting animal and the task-seeking psychologist

First, though, it is necessary to add a qualification to the assertion just made. If the task is defined as an epistemological construct, then it is a thing that is strictly artificial, invented for the benefit of the researcher. However, it is not the case that a researcher is justified in labelling just anything as a task. Nature must still possess joints to carve it at. In order for the analysis to be valid, the researcher's description of the task must correspond to what the actor is in fact doing. The task is a third-person device, but it must recognize that the actor occupies a particular first-person perspective.

Failing to take into account the first-person perspective of an actor is an old problem; it is a version of what William James named the psychologist's fallacy. The fallacy is committed when a researcher assumes the validity of a particular description of what the subject is doing which may correspond poorly to the actual mechanisms involved. In particular, the subject may have a very different view of things from the researcher.

[2] I here assume that three-way relations are not possible, or else must be reducible to a set of binary relations. I take it that if we allow for the existence of higher-order relations then it becomes possible to define a task at an arbitrary level of complexity (to describe the same activity in an arbitrarily large numer of ways), and it again becomes impossible to identify a single thing that constitutes *the* task.

This is illustrated by Martin Orne's (1962) work on research subjects' behaviour in hypnosis sessions. A question that arises for hypnotists is: when patients behave as if they are hypnotized, how does one know if they are really hypnotized? Might they not be perfectly aware but only simulating hypnosis for some reason (to avoid embarrassment, for example)? To investigate this, Orne tried to trick his subjects: he attempted to create the impression that the hypnotist had left the room during the session and that the subject was no longer being observed. A number of the subjects were convinced by this act and gave up the pretense that they had ever been hypnotized: they began moving about or even got up and wandered around the room. By doing so, they demonstrated clearly to an outside observer that they had in fact been simulating all along. What this demonstrates is that it is not sufficient for a psychologist to merely describe a situation as it appears from the outside: a third party observer may be inclined to take at face value any behaviour that looks like behaviour under hypnosis. Only by considering what the situation looks like from the point of view of the research subject is it possible to assess whether the third-party description is a valid one.

In what follows I have attempted to reserve the term *task* for referring to the researcher-defined unit of study, and to talk of the actor as acting or carrying out actions.

The task as a reconfiguration of resources

The discussion so far has attempted to identify what a task is not: it is not an entity in an actor's head, nor is it an arbitrary description drawn directly from a psychologist's intuitions. We must now attempt a definition of what a task is.

The solution that ecological psychologists arrive at is to define a task as a particular, characteristic reconfiguration of resources. That is, the task should have a precisely defined start and end point, and a recognizable mode of transition between the two. This is important because it provides a means to unite different instances of a single phenomenon as being instances of the same task, and not just a disparate set of individual things that happened. The word *resources* here can be defined quite broadly; the purpose is to pick out any component of the animal-environment system that is used as an instrument in completing the task, or that changes in a characteristic way over the course of the activity. This might be a change in some object or other structure in the environment, or might be a change in the animal itself. Thus, a ball-catching task is any instance of a catcher attempting to locomote from some initial position to a position where they can catch a ball which is following a parabolic trajectory through the air. A steering task is any instance in which a driver must control the motion of a car around a bend. And the task of learning to walk is characterized by a change in the infant, from being incapable of ambulating between one standing position and another to being capable of doing so.

The claim is that if we can characterize a specific reconfiguration that happens somewhere in the system, then we have defined a task. Subsequently, whenever the relevant conditions obtain, we are justified in characterizing what is happening as an instance of that task.

Notice that these task descriptions also specify criteria for successful completion of the task. The task is completed successfully if the ball is caught, if the car negotiates the bend without disaster, and if the infant eventually learns to walk. Furthermore, the fact that the task is defined as a precise reconfiguration of resources means that we also have a way of assessing whether we can further apply the analysis of the phenomenon under investigation to some novel phenomenon that has not itself been studied. Thus, the analysis of ball-catching should apply for catching any projectile that follows a parabolic trajectory through the air, but will not necessarily extend to explain how frisbees are caught or how goalkeepers in soccer move to stop bending free kicks.

It might be unclear whether learning can really be characterized as a task in the same way as the other activities. In the case of learning to walk, it looks like what is happening is a local change within the infant. One may be tempted to suggest that there is no reconfiguration of physical resources here—that the infant already has all of the necessary resources to be able to walk, and that what is needed is really a change in mental structure, which cannot be characterized from the outside. This would be quite wrong, however. It would be wrong partly for the obvious reason that any change in mental structure must also be a change in physical structure somewhere. But more importantly, learning to walk is not a process that occurs only inside the infant, but is one that involves the entire animal-environment system. The infant never exits the environment to practice in private. The way infants learn to walk is by exhaustive trial and error: repeatedly trying a few steps before falling down and trying again (Adolph et al., 2012). The falling down is part of the learning process, and the only way to tell whether one has fallen down is by attending to information from the environment. If what's being reconfigured is the animal-environment system and not just the animal, then the task of learning can in this instance be characterized from the outside after all.

Perhaps there are some activities that people engage in that cannot be characterized from the outside, and thus must remain out of reach for a psychology committed to empirical investigation based on the present definition of the task. An operation carried out entirely 'in the head' may be one such case. An example would be someone working through some particular sum without then making the solution 'external' in any way. Here the initial sum is being reconfigured into a solution, but there appears to be no means by which a psychologist could measure the outcome, and thus no way of charcterizing this from the outside as a task . This is certainly a limitation, but then again it's not clear why a psychologist would want to study this kind of thing: why bother asking people to work on sums if you are not going to check the answer in some way? Such operations carried out 'in the head' must remain elusive for empirical purposes, but this need not necessarily be a source of great concern.

More likely is that we can identify some phenomenon informally that we'd like to define as a task, but which turns out to be of such complexity that it's unclear where to posit a start and end point, or how to characterize what goes on in between. This presents an important practical limit on current empirical study, but also motivates the project of developing better tools for characterizing a broader range of tasks.

A. D. Wilson and Golonka (2013) outline a four-point procedure for applying the task-oriented approach to the general case: 1) identify the task: conduct a task analysis 'which characterizes from a first person perspective the specific task that a perceiving-acting cognitive agent is faced with'; 2) identify task-relevant resources available to the agent which can potentially be assembled in the carrying out of the task; 3) 'identify how the agent can assemble these resources into a system capable of solving the problem at hand'; and 4) recruit research subjects and have them perform the activity in order to test whether they do in fact carry it out in the fashion identified in (3). Clearly step (1) is crucial: it is necessary to define the task in a precise way at the outset if steps (2)-(4) are to be possible. We are presently concerned with what is presupposed by the first step: what does it take for something to count as a task? The suggestion is that the things we can characterize as tasks, and therefore the things we can study, are the things where we can identify a characteristic reconfiguration of resources with a clearly identifiable start and end point. If this formulation of the task is a good one, we can hope to be able to use it to extend the scope of the task-oriented approach beyond phenomena of the ball-catching type to encompass more complex activities.

Acting with other actors

A particularly acute test of the methodology will be how well it can be applied to activities involving more than one actor. This presents a notorious set of difficulties for psychologists working in the brain-oriented tradition: if action is the output of mental process, how can it be that some actions appear to be carried out by multiple actors? Cognitivists have attempted to resolve this by appealing to various mechanisms, including internal prediction processes, mirror mechanisms that are held to transmit mental content by contagion, and group minds (Sebanz, Bekkering, & Knoblich, 2006).

The task-oriented approach does not encounter this difficulty, because it does not posit that behaviour is the result of operations in a distinct mental realm. But there remains some ambiguity to be resolved. If a task is a third-person device for describing a first-person activity, what then are we to make of actions that are carried out by multiple individuals? If two people are rowing a boat together, how many tasks are there? Well, since the task on the present definition is a descriptive device rather than an aspect of reality to be discovered, the question is ill-formed: there isn't any pre-existing number of tasks to be untangled. The number of tasks there are depends on how we choose to define what constitutes a task.

Might it be useful to define a task as a thing carried out by the pair: the pair is the actor, and the task is what this pair does? This does not seem plausible. An individual is an experiencing perceiver-actor—an organism that goes about perceiving invariant structure in order to control action. A group of people is not an experiencing unit, and does not appear to possess any means of controlling its own actions, except through the actions of the individuals that make up the group.

In the rowing example, then, there must be two tasks. That is, we can define what is going on as two individuals each carrying out their own task. For one rower the task might be to set the pace and to carry out equally-spaced strokes with their oar, while for the other rower the task may be to match the first stroke-for-stroke, applying equal force on the opposite side of the boat. In this example, the pair will either succeed or not depending on whether or not the two rowers are able to coordinate their respective activities. But the apparent success of the pair is really a consequence of individual success on the part of the second rower. Of course, in reality things may not be so simple: the first rower may actively coordinate with the second, instead of merely setting the pace and letting the second do all the work of maintaining coordination. But the point is that as long as the individual tasks are defined in an appropriate way, there is no need to appeal to any additional process at the group level. The group level activity should already be defined in the individual tasks.

And to reiterate, the individual tasks are not private processes going on in the heads of the actors, but processes that span the animal-environment system. The distinguishing feature of a task that's carried out with others is that the environment happens to contain other animals who are also producing structure that is relevant to the task at hand.

Rationale for the task-oriented approach

Psychology has in recent history been defined as the science of mind, brain, and behaviour, or some combination of those three things. In any case, the unit of analysis is always taken to be the individual organism. Tasks have thus been understood as things that psychologists get subjects to do merely as a proximate source of data about the real phenomena hidden in the head. What reason could there be to give up on this formulation and to instead carve up the problem space into individual tasks, making the task the main unit of analysis?

An important rationale for the task-oriented approach comes from work on learning. Learning in infancy is shown to be thoroughly context-dependent, the child's general abilities arising out of immediate experience with local problems (Thelen & Smith, 1994). This context-dependency applies across a wide array of different activities, and at different points of development. One example comes from how infants learn to negotiate slopes when they are crawling versus when they have begun to walk. Crawling infants initially attempt to descend a slope head-first, even if the slope is too steep to negotiate. Through further exploration these children gradually learn to adapt their approach to slopes and will become increasingly cautious when faced with a steep descent. This cautiousness does not, however, transfer straightaway to the new task of walking: infants who have newly begun to walk are once again unable to perceive that a slope does not afford walking down and will attempt to descend when encouraged by an experimenter. This happens even though the same infants are perfectly capable of perceiving that the slope does not afford descent if they are placed in a crawling position at the top of the same slope (Adolph, Eppler, & Gibson, 1993). In a sense, the transition from crawling to walking means that the infant has to learn what its environment means all over again.

Thelen and Smith (1994) cite further examples of context-specific learning, including work on the 'shape bias' in children's object-naming, which is a phenomenon that emerges when children are specifically asked to name objects but not when they are merely asked to match objects with 'similar' targets; that is, the shape bias is dependent on the context of the experimenter's demands (Smith, Jones, & Landau, 1996). A similar context-dependent process is observed in normal language learning, in which children appear to initially use any given verb in only a handful of specific syntactic structures—the so-called 'verb island'. Only later do they begin to generalize, using novel verbs in syntactic structures where they have not previously been used (Tomasello, 2000).

And this task-specificity in learning does not appear be unique to young children. Evidence for similar context-specificity in later life learning comes from studies of brain training products which claim to promote improvement in general cognitive abilities. These studies have shown that although users of these products improve at the specific activities that are performed as part of the 'training' regime, there is no evidence that this learning transfers to novel activities (Owen et al., 2010).

So learning is context-specific, and thus one rationale for doing psychology one task at a time is that this does in fact appear to correspond to how we learn things. But doesn't this suggest that tasks are, after all, genuine components of the system, and not merely analyst-defined units? Tasks are the things we learn to do? No. This is just another confusion of description and reality. Contexts, like tasks, are not naturally distinct from one another. It's only when we look in from the outside that we can divide things up in this way. From the perspective of the learner, there is no thing which constitutes the context of the present, there is only the present, which is continuous with everything else the learner does. The point is only that the task-oriented description scheme may better correspond to reality than the brain-oriented scheme.

A further rationale comes from empirical success. The task-oriented approach has in fact been shown to produce hypotheses that better correspond to reality than those generated by the alternative general problem-solving approach. To return to the ball-catching example, the task-oriented approach here treats this as a problem to be solved by the catcher in a simple way: the catcher maintains visual attention upon the ball in flight in such a way that the ball appears to follow a linear path up and down (McBeath, Shaffer, & Kaiser, 1995). This predicts that the catcher will run in a curved line to intercept the ball, in contrast to the general problem solving approach which predicts that the catcher will perform an internal calculation in order to work out the optimal place to run to and will run to that spot in a straight line. In fact, catchers do follow a curved path before catching the ball, lending empirical support to the task-oriented hypothesis and suggesting that the internal-calculation hypothesis is false (A. D. Wilson & Golonka, 2013).

A final rationale here is a rationale from usefulness. Applied fields exist to solve practical problems. We'll take speech language therapy as an example. This field is not organized around the question of how speech is organized in the brain but around what can be done in practice to improve patients' speech in a measurable way. Treating children with articulation disorders is, for the speech therapist, a two-part task consisting of firstly improving the child's articulation of specific sounds, and secondly improving the child's systematic use of those sounds so that the child's improved pronunciation can be generalized to novel words and not just to the words they have already practiced (Gierut, 1998). This particular treatment technique uses precisely a task-oriented approach, on the present definition. Treating an articulation problem as a task to be solved is useful, and even a necessary pre-requisite for devising an effective treatment methodology.

Final definition: what is a task?

The discussion in the preceding sections allows us to state the following as a definition of a task.

> A task is an analyst-defined unit that corresponds to a recognizable reconfiguration of resources in an animal-environment system, which:
>
> 1. is meaningful from a first person perspective; it presents opportunities to act and constrains possible solutions,
> 2. can be defined precisely, has a start and end point, and a transition between them, that can all be directly observed,
> 3. specifies criteria for successful completion,
> 4. specifies conditions under which conclusions can be generalized to similar tasks.

I'll here address a couple of possible objections to the task-oriented approach. Firstly, if the objective is to study individual tasks one at a time, isn't this just massive modularity by another name? No. Massive modularity, like Fodor's non-massive version, still appeals to modules in the brain that are not directly observable. The task-oriented approach by contrast, is concerned with disruptions of physical resources that can in principle be measured directly: the physical resources *are* the task; they are not measured as a proxy for investigating a hypothetical construct in the brain.

Secondly, if the task-oriented approach is all about coming up with useful characterizations of specific, circumscribed phenomena, that's all well and good, but it can never lead to a complete picture, either of how the brain works or of how the animal-environment system works. I think this objection is perfectly valid, except that it characterizes as a limitation what could equally be seen as a strength. The strength is that the task-oriented approach leads to immediately useful conclusions. By contrast, suppose we had a perfect model of the brain, assuming such a thing to be possible. That model would be a monumental scientific achievement, but it would still only be useful for solving particular questions we might ask it—that is, for addressing specific tasks. The task-oriented approach is a means of not having to wait for that model to be finished, it is a tool for solving practical problems in the present. In fact, this is a similar conclusion to the one Fodor (1983) arrived at. Modularity, it was hoped, might work as a methodological tool for studying peripheral input systems such as language and vision, but it cannot give an account of central cognition or thinking: 'The ghost has been chased further back into the machine, but it has not been exorcised'.

I'll make one final point. A current debate in cognitive science opposes a traditional symbol-manipulating disembodied view of cognition with various purportedly embodied alternatives (M. Wilson, 2002; Shapiro, 2011). Or more exotically, the view of the mind as an internal property of an organism is opposed to the 'extended mind' which is said to span brain, body, and environment (Menary, 2010). These debates make a dichotomy in the ontological claims supposedly made by two incompatible camps. This frequently leads to fruitless discussions on the question of *what* we should call 'cognitive': can external symbols constitute mental content or must mental content be confined to the head? In the present paper I have emphasized a different kind of dichotomy, on methodological rather than ontological lines, between a brain-oriented and a task-oriented approach to doing empirical psychology. I suggest that this difference in methodology is real and unambiguous, and that the dichotomy is a useful one. Making the dichotomy on methodological lines allows us to concentrate not on what our ultimate model should look like, but on *how* to make empirical progress towards it by investigating real phenomena that we are interested in.

The case in favour of the task-oriented approach ultimately rests on its usefulness. The approach may serve as a useful general framework for psychological study, if the concept of a task can be defined in a precise way. The present discussion suggests that it can be, and further proposes that the task is a viable solution to Fodor's problem of how psychological research can be organized. The challenge that arises is the following. If we want to study psychology in a tractable way, we have a choice between two options: there are modules, and there are tasks.

Acknowledgements

I thank Holly Branigan and Jon Oberlander for their comments.

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