Reflection essay on transfer of learning

Transfer of learning is the study of the dependency of human conduct, learning, or performance on prior experience. The notion was originally introduced as transfer of practice by Edward Thorndike and Robert S. Woodworth. They explored how individuals would transfer learning in one context to another context that shared similar characteristics – or more formally how " improvement in one mental function" could influence another related one.

Their theory implied that transfer of learning depends on the proportion to which the learning task and the transfer task are similar, or where " identical elements are concerned in the influencing and influenced function", now known as identical element theory. Transfer research has since attracted much attention in numerous domains, producing a wealth of empirical findings and theoretical interpretations.

However, there remains considerable controversy about how transfer of learning should be conceptualized and explained, what its probability occurrence is, what its relation is to learning in general, or whether it may be said to exist at all. Most discussions of transfer to date can be developed from a common operational definition, describing it as the process and the effective extent to which past experiences (also referred to as the transfer source) affect learning and performance in a current novel situation (the transfer target) (Ellis, 1965; Woodworth, 1938).

This, however, is usually where the general consensus between various research approaches ends. Transfer taxonomies Of the various attempts to delineate transfer, typological and taxonomic approaches belong to the more common ones (see, e. g. , Barnett & Ceci, 2002; Butterfield, 1988;

Detterman, 1993; Gagne, 1977; Reeves & Weisberg, 1994; Salomon & Perkins, 1989; Singley & Anderson, 1989). Taxonomies are concerned with distinguishing different types of transfer, and therefore less involved with labeling the actual vehicle of transfer, i. e. , what is the explanatory mental unit of transfer that is carried over.

Hence, a key problem with many transfer taxonomies is that they offer an excessive number of labels for different types of transfer without engaging in a discussion of the underlying concepts that would justify their distinction; i. e. , similarity and the nature of transferred information. This makes it very difficult to appreciate the internal validity of the models. The following table presents different types of transfer, as adapted from Schunk (2004, p. 220). TypeCharacteristics NearOverlap between situations, original and transfer contexts are similar. FarLittle overlap between situations, original and transfer settings are dissimilar.

PositiveWhat is learned in one context enhances learning in a different setting. NegativeWhat is learned in one context hinders or delays learning in a different setting. VerticalKnowledge of a previous topic is essential to acquire new knowledge. HorizontalKnowledge of a previous topic is not essential but helpful to learn a new topic. LiteralIntact knowledge transfers to new task. FiguralUse some aspect of general knowledge to think or learn about a problem. Low RoadTransfer of well-established skills in almost automatic fashion. High RoadTransfer involves abstraction so conscious formulations of connections between contexts.

High Road/Forward ReachingAbstracting situations from a learning context to a potential transfer context. High Road/Backward ReachingAbstracting in the transfer context features of a previous situation where new skills and knowledge were learned. Apart from the effect-based distinction between negative and positive transfer, taxonomies have largely been constructed along two, mostly tacit, dimensions. One concerns the predicted relationship between theprimary and secondarylearning situation in terms of the categorical overlap of features and knowledge specificity constraints.

The other concerns general assumptions about how transfer relationships are established, in terms of mental effort and cognitive process. The effect-perspective: positive vs. negative transfer Starting by looking at the effect side of transfer – in terms of the common performance criteria, speed and accuracy – transfer theories distinguish between two broad classes that underlie all other classifications: negative andpositive transfer. Negative transfer refers to the impairment of current learning and performance due to the application of non-adaptive or inappropriate information or behavior.

Therefore, negative transfer is a type of interference effect of prior experience causing a slow-down in learning, completion or solving of a new task when compared to the performance of a hypothetical control group with no respective prior experience. Positive transfer, in contrast, emphasizes the beneficial effects of prior experience on current thinking and action. It is important to understand that the positive and negative effects of transfer are not mutually exclusive, and therefore real-life transfer effects are probably mostly a mixture of both.

Positive transfer: transfer of learning or training is said to be positive when the learning or training carried out in one situation proves helpful to learning in another situation. Examples of such transfer are: •the knowledge and skills related to schoolmathematicshelp in the learning of statistical computation; •the knowledge and skills acquired in terms of addition and subtraction in mathematics in school may help a child in the acquisition of knowledge and skills regarding multiplication and division; •learning to play badminton may help an individual to play ping pong (table tennis) and lawn tennis.

The situation perspective: specific vs. general, near vs. far transfer The situation-driven perspective on transfer taxonomies is concerned with describing the relation between transfer source (i. e. , the prior experience) and transfer target (i. e. , the novel situation). In other words, the notion of novelty of the target situation per se is worthless without specifying the degree of novelty in relation to something that existed before. Butterfield and Nelson (1991), for example, distinguish between within-task, across-task, and inventive transfer.

A similar classification approach reappears in many situation-driven transfer taxonomies (e. g. , similar vs. different situations, example-to-principle and vice versa, simple-to-complex and vice versa) and can be noted as distinctions made along the specific vs. general dimension. Mayer and Wittrock (1996, pp. 49ff.) discuss transfer under the labels of general " transfer of general skill" (e. g. , " Formal Discipline", Binet, 1899), " specific transfer of specific skill" (e. g. , Thorndike’s, 1924a, b, " identical elements" theory), " specific transfer of general skill" (e. g. Gestaltists' transfer theory, see origins with Judd, 1908), and " meta-cognitive control of general and specific skills" as a sort of combination of the previous three views (see, e. g. , Brown, 1989). Haskell's (2001) taxonomy proposes a more gradual scheme of similarity between tasks and situations. It distinguishes between non-specific transfer (i. e. , the constructivist idea that all learning builds on present knowledge), application transfer (i. e. , the retrieval and use of knowledge on a previously learned task), context transfer (actually meaning context-free transfer between similar tasks), near vs. ar transfer, and finally displacement or creative transfer (i. e. , an inventive or analytic type of transfer that refers to the creation of a new solution during problem solving as a result of a synthesis of past and current learning experiences). Both near and far transfer are widely used terms in the literature. The former refers to transfer of learning when task and/or context change slightly but remain largely similar, the latter to the application of learning experiences to related but largely dissimilar problems. The process perspective

The specific vs. general dimension applies not just to the focus on the relation between source and target, i. e. , from where to where is transferred, but also to the question about the transfer process itself, i. e. , what is transferred and how. Reproductive vs. productive transfer (see Robertson, 2001) are good examples of this type of distinction, whereas reproductive transfer refers to the simple application of knowledge to a novel task, productive transfer implies adaptation; i. e. mutation and enhancement of retained information.

A similar dichotomous distinction is the one between knowledge transfer and problem-solving transfer (Mayer & Wittrock, 1996). Knowledge transfer takes place when knowing something after learning task A facilitates or interferes with the learning process or performance in task B. Knowledge used is referred to by many different terms, such as declarative or procedural types

(Anderson, 1976), but it means that there are representational elements that suit A and B. Problem solving transfer, on the other hand, is described as somewhat more " fluid knowledge" transfer, so that experience in solving a problem A helps finding a solution to problem B.

This can mean that the two problems share little in terms of specific declarative knowledge entities or procedures, but call for a similar approach, or solution search strategies (e. g. , heuristics and problem solving methods). The issues discussed in problem-solving transfer literature are also closely related to the concepts of strategic and theoretic transfer (Haskell, 2001, p. 31), and cognitive research on analogical reasoning, rule-based thinking and meta-cognition.

Indeed, far transfer can be considered as the prototypical type of transfer, and it is closely related to the study of analogical reasoning (see also Barnett & Ceci, 2002, for a taxonomy of far transfer). Within the problem-solving literature the distinction between specific and general methods is made mostly with reference to Newell and Simon's (1972) strong vs. weak problem solving methods (Chi, Glaser & Farr, 1988; Ericsson & Smith, 1991; Singley & Anderson, 1989; Sternberg & Frensch, 1991). Another concern that is frequently addressed in transfer taxonomies is the question of conscious effort.

High-road vs. low-road transfer (Mayer & Wittrock, 1996; Salomon & Perkins, 1989) expresses a distinction between such instances of transfer where active retrieval, mapping, and inference processes take place, as opposed to those instances that occur rather spontaneously or automatically. Hence, low-road transfer concerns frequently employed mental representations and automated, proceduralized knowledge, and occurs preferably in near transfer settings. In contrast, high-road transfer is more conception-driven, and requires cognitive and meta-cognitive effort. Traditional fields of transfer research

There are a nearly unlimited number of research fields that share some applied interest into the study of transfer, as it pertains to learning in general. Three fields that contributed in most substantial ways to the progress of transfer research, both from a conception and empirical point of view, are the fields ofeducationscience, linguistics, and human-computer interaction (HCI). In fact, most transfer research has been conducted in reference to one of these applied settings, rather than in basic cognitive psychological laboratory conditions. Education science: teaching for transfer

Due to their core concern with learning, educational science and practice are the classic fields of interest regarding transfer research, and probably the prime target for the application of theories. Transfer of learning represents much of the very basis of the educational purpose itself. What is learned inside one classroom about a certain subject should aid in the attainment of relatedgoalsin other classroom settings, and beyond that it should be applicable to the student's developmental tasks outside the school; the need for transfer becomes more accentuated.

This is because the world educators teach in today is different from the world they themselves experienced as students, and differs equally from the one their students will have to cope with in the future. By nature of their applied interest, educationalists' main concern has been less with the question of how transfer takes place, and much more with under what conditions, or, that it happens at all. The basic conviction that student's learning and achievement levels depend primarily on learning and achievement prerequisites, has constituted a central part in educational learning theories for quite some time (Gage & Berliner, 1983; Glaser, 984). The major focus in educational transfer studies has, therefore, been on what kind of initial learning enables subsequent transfer: teaching for transfer. Research on learning and transfer has identified key characteristics with implications for educational practice. From Formal Discipline to meta-cognition Educational transfer paradigms have been changing quite radically over the last one hundred years.

According to the doctrinaire beliefs of the Formal Discipline (Binet, 1899) transfer was initially viewed as a kind of global spread of capabilities accomplished by training basic mental faculties (e. g. , logic, attention, memory) in the exercise of suitable subjects, such as Latin or geometry. With the turn of the 20th century, learning, and therefore transfer of learning, was increasingly captured in behavioral and empiricist terms, as in the Connectionist and Associationist theories of Thorndike (e. g. , 1932), Guthrie (e. g. , 1935), Hull (e. g. , 1943), and Skinner (e. g. , 1938).

Thorndike (1923, 1924a and b) attacked the Formal Discipline empirically and theoretically and introduced the theory of " identical elements", which is probably still today the most influential conception about transfer (Thorndike, 1906; Thorndike & Woodworth, 1901a, b and c). Thorndike's belief that transfer of learning occurs when learning source and learning target share common stimulus-response elements prompted calls for a hierarchical curricular structure in education. " Lower" and specific skills should be learned before more complex skills, which were presumed to consist largely of configuration of basic skills.

This small-to-large learning, also referred to as part-to-whole or vertical transfer, has been popular with theories of learning hierarchies (Gagne, 1968). It has later been challenged from conceptualistic point of views, which argue that learning is not just an accumulation of pieces of knowledge (i. e. , rote memorization), but rather a process and product of active construction of cognitive knowledge structures (Bruner, 1986; Bruner, Goodnow & Austin, 1956). Knowledge, from a constructivist perspective, was no more believed to be a simple transfer by generalization to all kinds of situations and tasks that contain similar components (i. . , stimulus-response patterns; see also Logan, 1988; Meyers & Fisk, 1987; Osgood, 1949; Pavlov, 1927). The critical issue was the identification of similarities in general principles and concepts behind the facades of two dissimilar problems; i. e. , transfer by insight. This idea became popular in the Gestaltists' view on transfer (e. g. , Katona, 1940), and, in combination with growing interest in learners as self activated problem-solvers (Bruner, 1986), encouraged the search for abstract problem-solving methods and mental schemata, which serve as analogy-enhancing transfer-bridges between different task situations.

Emerging from these developments, a new theme started to dominate educationalists' research in transfer: meta-cognition (Brown, 1978; Brown & Campione, 1981; Campione & Brown, 1987; Flavell, 1976). In contrast to classical knowledge forms like declarative and procedural knowledge, different types of meta-knowledge and meta-cognitive skills such as strategic knowledge, heuristics, self-monitoring skills, and self-regulation quickly became the road to learning and transfer.

Characterized as self-conscious management and organization of acquired knowledge (Brown, 1987) it is evident that meta-cognitive awareness of task features, problem structures, and solution methods makes relations between different situations cognitively salient: only an individual who learns from learning, learns for future learning. Soini (1999) developed on the same core ideas an examination of the preconditions for active transfer. Her emphasis is on the active and self-reflected management of knowledge to increase its accessibility.

To some researchers, meta-cognition and transfer have become so entangled that the argument was generated that only the measurement of positive transfer effects truly supports inferences that meta-cognitive learning has taken place (e. g. MacLeod, Butler & Syer, 1996). The generality predicament: return to the specificity view Ever since the introduction of the meta-knowledge theme in education science, transfer discussions have been oscillating between the position taken by those representing the meta-cognitive view and those whostressthat generic knowledge forms alone do not allow an effective transfer of learning.

When knowledge stays " on the tip of the tongue", just knowing that one knows a solution to a problem, without being able to transfer specific declarative knowledge (i. e. , know-what) or automated procedural knowledge (i. e. , know-how), does not suffice. Specific teaching of the cognitive and behavioral requisites for transfer marked in principle a return to the identical element view, and can be summarized with Dettermann's

(1993) conclusion that transfer does not substantially go beyond the restricted boundaries of what has been specifically taught and learned.

The basic transfer paradigms in educationalpsychologykeep replicating themselves, and fundamental promotion of transfer itself is seen to be achievable through sensibilization of students by creating a generalcultureand " a spirit of transfer" inside the classroom on the one hand, and by allowing concrete learning from transfer models on the other (Haskell, 2001). Learning and transfer: implications for educational practice A modern view of transfer in the context of educational practice shows little need to distinguish between the general and specific paradigms, recognizing the role of both identical elements and metacognition.

In this view, the work of Bransford, Brown and Cocking (1999) identified four key characteristics of learning as applied to transfer. They are: 1. The necessity of initial learning; 2. The importance of abstract and contextual knowledge; 3. The conception of learning as an active and dynamic process; and 4. The notion that all learning is transfer. First, the necessity of initial learning for transfer specifies that mere exposure or memorization is not learning; there must be understanding.

Learning as understanding takes time, such that expertise with deep, organized knowledge improves transfer. Teaching that emphasizes how to use knowledge or that improvesmotivationshould enhance transfer. Second, while knowledge anchored in context is important for initial learning, it is also inflexible without some level of abstraction that goes beyond the context. Practices to improve transfer include having students specify connections across multiple contexts or having them develop general solutions and strategies that would apply beyond a single-context case.

Third, learning should be considered an active and dynamic process, not a static product. Instead of one-shot tests that follow learning tasks, students can improve transfer by engaging in assessments that extend beyond current abilities. Improving transfer in this way requires instructor prompts to assist students – such as dynamic assessments – or student development of metacognitive skills without prompting. Finally, the fourth characteristic defines all learning as transfer.

New learning builds on previous learning, which implies that teachers can facilitate transfer by activating what students know and by making their thinking visible. This includes addressing student misconceptions and recognizing cultural behaviors that students bring to learning situations. A student-learning centered view of transfer embodies these four characteristics. With this conception, teachers can help students transfer learning not just between contexts in academics, but also to common home, work, or community environments. Inter-language transfer

Another traditional field of applied research is inter-language transfer. Here, the central questions were: how does learning one language (L1) facilitate or interfere (Weinreich, 1953) with the acquisition of and proficiency in a second language (L2), and how does the training and use of L2, in turn, affect L1? Several variations of this conception of inter-language transfer can be found in the literature, also referred to asmother tongueinfluence or cross language interference (Corder, 1983, 1994; Faerch & Kasper, 1987; Jiang & Kuehn, 2001; Odlin, 1989; O'Malley nd Chamot, 1990). What makes inter-language transfer a complex and valuable research matter is the fact that language knowledge skills continuously develop. This is so for L1, as well as for L2, when only bilingualism is considered, while alternately at least one of them is continuously in use. This has led to the development of very different models of how languages are mentally represented and managed, with L1 and L2 seen as two independent or autonomous mental systems (e. g. Genesee, 1989; Grosjean, 1989), as being represented in a single unified system (e. g.

Redlinger & Park, 1980; Swain, 1977), and as rooting in a common underlying, multi-lingual conceptual base (CUCB; see Kecskes & Papp, 2000). Human-Computer Interaction: designing for transfer A third research area that has produced a variety of transfer models and empirical results can be located within the field of Human-Computer Interaction (HCI). With the start of the user age in the 1980s, HCI and all kinds of virtual environments have, in many ways, become something like psychological micro-worlds for cognitive research. This is naturally also reflected in the study of transfer.

Developments in favor of cognitive approaches to transfer research were especially accelerated by rapid changes in modern lifestyles, resulting in a virtual upsurge of cognitive demands in interaction withtechnology. Thus, the call was on clearly domain-focused cognitive models to study the way users learn and perform when interacting with information technological systems (Card, Moran & Newell, 1980a and b, 1983; Olson & Olson, 1990; Payne & Green, 1986; Polson, 1987, 1988). Transfer based on the user complexity theory Thorough investigations of cognitive skills involved in HCI tasks have their origins with the research on text editing (e. . , Kieras &

Polson, 1982, 1985; Singley & Anderson, 1985). The offspring of this type of research were computational cognitive models and architectures of various degrees of sophistication, suitable for all kinds of man-machine interaction studies, as well as studies outside of the HCI domain. The original examples for these have become Kieras and Polson's (1985) user complexity theory (later rephrased as cognitive complexity theory) and the GOMSfamily(i. e. , Goals, Operators, Methods, Selection) rules based on the Model Human Processor framework (Card et al. , 1980a and b, 1983; John & Kieras, 1996a and b).

All of these models have their roots in the basic principles of production systems and can be comprehended with the help of ends-means-selections and If-Then-rules, combined with the necessary declarative and procedural knowledge (Anderson, 1995; Newell & Simon, 1972). The crucial perspective for transfer became that of technology design. By applying cognitive models, scientists and practitioners aimed at minimizing the amount and complexity of new knowledge necessary to understand and perform tasks on a device, without trading off too much utility value (Polson & Lewis, 1990).

A keyresponsibilitywas given to skill and knowledge transfer. Due to the fact that the cognitive complexity theory is a psychological theory of transfer applied to HCI (Bovair, Kieras, & Polson, 1990; Polson & Kieras, 1985), the central question was how these models, united under the GOMS umbrella, can be used to explain and predict transfer of learning. The basic transfer-relevant assumptions of the emerging models were that production rules are cognitive units, they are all equally difficult to learn, and that learned rules can be transferred to a new task without any cost.

Because learning time for any task is seen as a function of the number of new rules that the user must learn, total learning time is directly reduced by inclusion of productions the user is already familiar with. The basic message of the cognitive complexity theory is to conceptualize and induce transfer from one system to another by function of shared production rules, which is a new interpretation of Thorndike's (1923, 1924a and b) identical element premise and eventually echoed in Singley and Anderson's (1989) theory of transfer (Bovair et al. 1990; Kieras & Bovair, 1986; Polson & Kieras, 1985; Polson, Muncher & Engelbeck, 1986). A practical implication of the procedural communality principle has been formulated by Lewis and Rieman (1993), who suggest something like " transfer of design" on the side of the industry: " You should find existing interfaces that work for users and then build ideas from those interfaces into your systems as much as practically and legally possible. " Emergence of holistic views of use

Discouraged by the confined character of the GOMS-related transfer models, many research groups began to import and advance new concepts, such as schemata principles and general methods; a general development encouraged by the emerging cognitive approach to transfer that was also witnessed by other applied fields. Bhavnani and John (2000) analyzed different computer applications and strived to identify such user strategies (i. e. , general methods to perform a certain task), which generalize across three distinct computer domains (word processor, spreadsheet, and CAD).

Their conclusive argument is that " strategy-conducive systems could facilitate the transfer of knowledge" (p. 338). Other research groups' authors that assessed the questions about how people learn in interaction with information systems, evaluated the usefulness of metaphors and how these should be taken into consideration when designing for exploratory environments (e. g. Baecker, Grudin, Buxton, & Greenberg, 1995; Carroll & Mack, 1985, Condon, 1999).

As researchers became increasingly interested in the quality of a user's knowledge representation (e. g. , Gott, Hall, Pokorny, Dibble, & Glaser, 1993), mental models and adaptive expertise, as knowledge and skills which generalizes across different contexts of complex problem-solving tasks, became of paramount concern (Gentner & Stevens, 1983; Gott, 1989; Kieras & Bovair, 1984). In contrast to the knowledge of strategies (Bhavnani & John, 2000), the accentuation shifted towards strategic knowledge (Gott et al. 1993). Gott et al. demonstrated that surface similarities between different technical domains alone did not essentially facilitate transfer of learning because they limited the user's flexibility in the adaptation process. In accordance with the ideas of schema-based and meta-cognitive transfer, the authors further formulated that " robust performance is one in which procedural steps are not just naked, rule-based actions, but instead are supported by explanations that perform like theories to enable adaptiveness" (p. 60). Gott et al. (1993) finally noted that mental models might be powerful instruments to analyze similarities between tasks as represented within a formulated cognitive architecture. However, they do not explain what particular similarities and differences are sufficiently salient from the individual's mental point of view to affect transfer of learning, nor can they predict motivational or emotional conditions of transfer that are essential requisites for every learning process.