Computer Game Playability – Learning Through Gameplay Design

Hazel Bradshaw[1]

[1], *Leeds Metropolitan University, Headingley Campus, Beckett Park, Leeds, LS6 3QS, UK, H.Bradshaw@LMU.ac.uk, Leeds Metropolitan University*

Abstract

Well-designed gameplay shares characteristics with effective learning experiences. Through analysis of commercial computer games we established that a successful game is a series of goal related skills increasing in difficulty until attainment of the overall goal is achieved. Kiili (2005) offers support when describing online games as satisfying the basic requirements of learning environments which provide engaging learning experiences for students.

This paper discusses the development of research conducted in the design of a cost effective playability process for independent game developers. This research forms the basis of an effective teaching system for entertainment-based education where concept development and narrative progression are delivered through interactive mediums, with further research focused in the creation of effective virtual learning interfaces represented through the rise in 'serious' gaming. The playability concept is being currently tested within a development environment in conjuncture with industry partner 'Team 17', an independent UK computer games developer.

Keywords

Playability, Human Performance, learning theory, interactive learning environments, gameplay

1 Introduction

In the field of Human Performance psychology, Fitts and Posner (1967) state 'we learn through acquiring skills and skilled performance always involves organised sequences of activities. Organisation, goal directedness and utilisation of feedback are basic characteristics of a skilled performance'. From this evidence it is reasonable to describe computer gameplay as a learning experience. Through our research we argue that designing computer game 'playability' by applying psychological principles can enhance the enjoyment and effectiveness of the player experience, while aiding the game developer in the design process. Additionally we anticipate that these principles can be applied to the design of any game interaction where learning takes place, opening design opportunities for educationally focused learning through interactive gameplay.

One of the goals of this work is to understand which key elements give a player the most satisfaction, enjoyment and motivation, during interaction in a computer game virtual environment. The psychological principles of 'Human Performance' and 'Learning Theory' can be applied to anticipate player reaction, given certain gameplay key-events and opportunities Bradshaw (2004). In understanding the psychological needs of the game-player when making sense of a new environment, we have been able to develop a simple model which aids the design and delivery of effective, enjoyable gameplay/learning experiences.

Advantages of applying a model of 'playability' or 'learning gameplay' to the design of game environments, aid the game-developer and the player experience through:

- Application of a flexible framework acting as a sophisticated 'check list', helping the gameplay strategy be at its most effective for player progression, enjoyment and motivation. Achieved though the careful design of goal related skills & tasks.

- Being able to utilise the relationship between learning gameplay and narrative progression, helps developers create more effective interactive scenarios. Enabling production teams to focus on the playability, from the point of view of the player.

This paper outlines the psychological principles behind the design of the model. It gives a breakdown of those principles applied the within the model, leading to the 'structural playability design' model for interactive learning environment, gameplay.

2 What is Playability/Learning Gameplay Theory?

The development of the playability concept is grounded in the cognitive principles of Human Performance, where skilled behaviour is goal directed and requires sequential activity. There are two sets of cognitive parameters outlined in human performance that can be applied to the design of 'learning-gameplay' these are described in the following text as the 4 playability principles and 3 phases of skill learning.

2.1 Playability Principles

Through investigation into Human Performance theory, there appear to be four basic principles which aid a skilled performance. If these principles are active in a learning environment where a task is undertaken to learn a new skill, then that environment can be considered to be optimised towards an effective learner experience. We are able to describe computer game environments as interactive learning environments and as such can translate Human Performance principles into gameplay terms.

The four psychological principles of human performance are:

1. Skilled performance always involves an organised sequence of activities
2. Skilled behaviour is goal directed
3. The full complexity of sequential activity can seldom be understood except when the end objective or goal is also understood
4. Each act is dependant upon comparison of what they think is desired, either through feedback (external stimuli) or comparison of progress towards a goal.

In terms of optimising for a 'learning-gameplay' experience the 4 playability principles are:

1. Structural principle – A logical gameplay structure forms the best experience for skilled performance
2. Goal principle – Any task that requires some skill has to aid you in the attainment of your goal
3. Clarity principle – Make the goal clear to your player from the start of the task, so they can understand why they are undertaking the task.
4. Comparison principle - The player needs a (visual or tactile) response to their actions to be able to compare how well they are doing in relation to their desired outcome or alternatively the player needs to know how their actions have progressed them in the attainment of their goal.

2.2 Phases of Skill Learning

According to the seminal work of Fitts & Posner (1967) the learner acquires the skills required of them by passing though the 3 Phases of Skill Learning. Schmidt & Lee (2005) recognise the phases of skill learning as characteristics of the learning process in their work Motor Control and Learning, a behavioural emphasis. They draw on "the three-phase (or stage) view of learning suggested by Fitts (1964, Fitts & Posner 1967) and later Anderson (1982, 1995)". Schmidt & Lee utilise this theory when describing real world physical action

& reaction. We shall be applying this theory cognitively to understand player reaction within a game-world, and we suggest that by designing gameplay which supports the players' journey though each skill phase, the probability of a successful interaction with that environment is increased and subsequently the learning experience is improved.

The following text outlines the 3 phases of skill learning and gives an example of where they might occur in gameplay design.

2.2.1 Early or Cognitive Phase

Where a learner tries to understand the task and what is being demanded of them

- A good instructor calls attention to the perceptual cues, response characteristics & gives diagnostic knowledge of results.
- Behaviour can be shaped by affirming sequences of acts that resemble the correct one (positive feedback)

In gameplay this could be a tutorial level or on screen instructions. The player would be able to call upon these elements until completion of the task, as removal would be frustrating and unrewarding for player progression.

2.2.2 Intermediate or Associative phase

In this phase new patterns of skill are utilised that are based on the skills learnt in the cognitive phase. In this phase you should be showing a marked reduction in large mistakes.

- Frequent rest periods will facilitate performance especially in motor skills as lack of muscle rest creates incorrect practice as muscles tire.
- If the task is too complex to practise as a whole then practice in its separate components.

In gameplay, choose items that are nearly independent of each other and alternate between practising the item and the whole task. Players can practise individual skills such as jumping while still progressing in attainment of the overall goal. Cut scenes make good rest periods alongside other simpler activities drawing upon skills already learnt.

2.2.3 Final or autonomous phase

The skills learnt become increasing automatic.

- The learner thinks less about what they do and outside stimulus has less affect.

In gaming the player needs less direction in the gameplay, new more challenging skills and environments can be introduced. Combine tasks when learning a skill at this stage. If one task has a level of predictability it can be learnt in combination with another task and both will see improvement. This can be seen in a player's ability to combine a jump, punch and kick into one move in aid of a new task.

These phases are parallel in their similarity to stages of difficulty in a gameplay. They can be applied to the start and end of a playing level or form the complete game strategy. They can also be contained as elements within themselves as subsets within the greater game concept. The key is not to miss out a phase or its key-elements as the learning experience then becomes flawed. Keeping these phases in mind when designing a computer game concept, level or module you should be able to create a platform for playability and learning gameplay.

The work of Malone and Lepper (1987) supports a playability/learning gameplay theory, when they discuss the factors that promote intrinsic motivation in a learner's behavior. The factors they present are; challenge, curiosity, control, fantasy, competition, cooperation and recognition. These are too many to address in this paper, but, as an example, the 'challenge' factor states 'people are best motivated when working towards a personally meaningful goal whose attainment requires activity at a continuously optimal (intermediate) level of

difficulty'. Here they touch on two of key-elements in the playability model's premise, the idea that learning is goal directed and goal attainment requires activities at an intermediate phase of skill learning.

Improved performance is not just 'practice' dependant. It needs to induce a cognitive desire within the player to push forward with the tasks (motivation). Applying playability design should increase motivation as it is sympathetic to the cognitive needs of the learner/player. Feedback is part of motivation, and can be given through scores, achievements, rewards, commiserations or encouragement, combined with the knowledge that there is opportunity for improvement and progression towards the desired goal.

3 Application to Gameplay Design

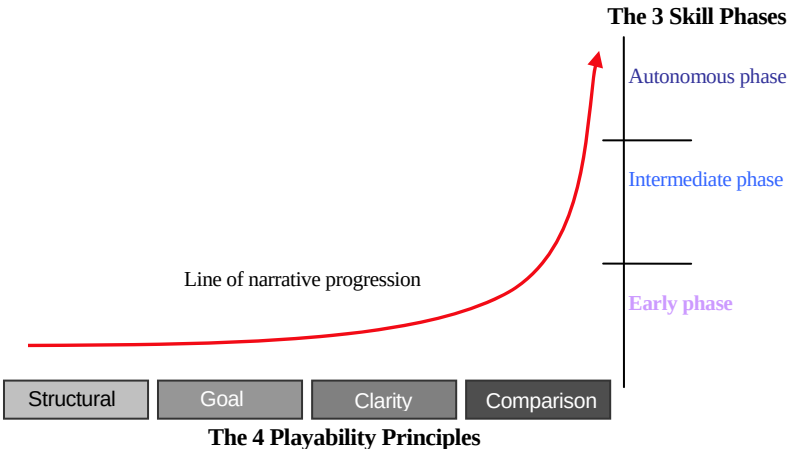

Figure 1: Structural Playability model v1

The basis for this model is illustrated in Figure 1, Structural Playability model v1, where the playability theory is applied as a system which uses the narrative structure of the environment as the means to map and develop the creative aspects of the gameplay. It requires that the user end-goal is defined before any technical development takes place. This ensures that a basic framework is developed early in the project and that all subsequent work is developed within that framework.

The designer benefits from this approach by having a translation tool for developing the creative narrative/learning strategy into a technical process. The result is a clear, simple system where design and production can be effectively managed without compromising the learning/gameplay goals.

3.1 Structural Playability Design Model for Learning Gameplay

The Structure Playability Design model was devised as a way to visually represent the psychological process of learning gameplay to an audience of game developers in a way that they could equate to their own working practices. It represents a preliminary system for mapping in-game playability. Understanding how effective gameplay can be best designed would benefit the working practices of industry, generating good practice in creative gameplay development, with the ultimate goal being a positive, motivating end-user experience. In Figure 2, the Structural Playability Design model represents the development process of an interactive learning environment (computer game), which imbeds the playability principles and phases of skill learning needed for generating a skilled performance and ultimately an effective learning experience.

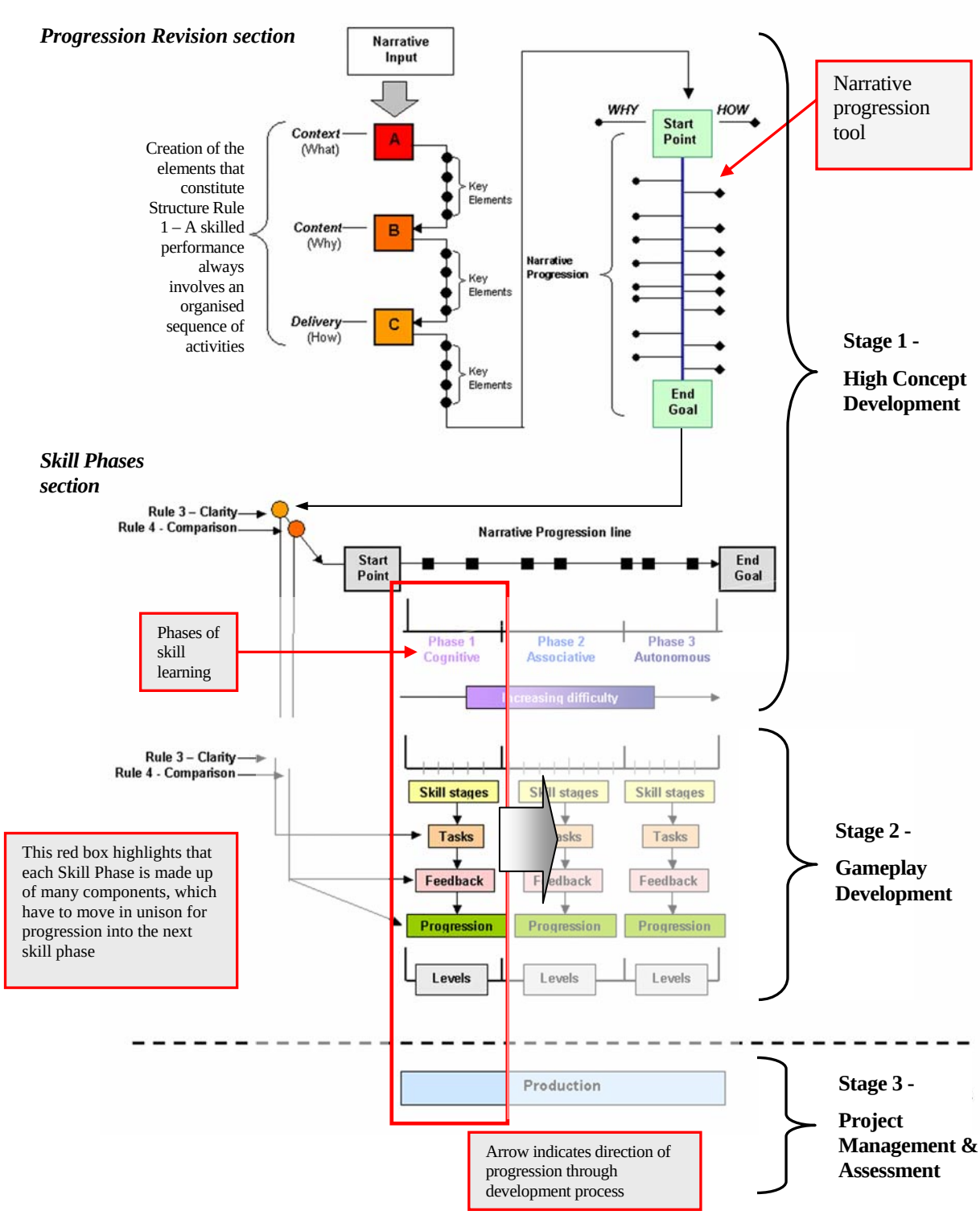

Figure 2: Structural Playability Design model

The model comprises of 3 stages of development. Stage 1 - High Concept Development, Stage 2 - Gameplay Development and Stage 3 - Project Management and Assessment. The following text describes the function of the two sections of Stage 1;

- the Progression Revision section and,
- the Skill Phases section.

The Progression Revision section refers to the progression of the narrative in its main role as driver of the gameplay design. The term revision allows for the cyclic nature of the creative design process. Figure 3 – Narrative Input, outlines how the overarching game narrative is

broken-down into key-elements to be used as the building blocks of the playability mapping process. The process of defining AB&C helps us to fulfil the 1st playability principle; a logical gameplay structure forms the best experience for skilled performance:

- ***'A - Context'* (What);** what is the role and goals of the player within the proposed narrative
- ***'B - Content'* (Why);** the key content of the game. (Why is the player doing what they are doing?)
- ***'C - Delivery'* (How);** how will the contents will be delivered on screen.

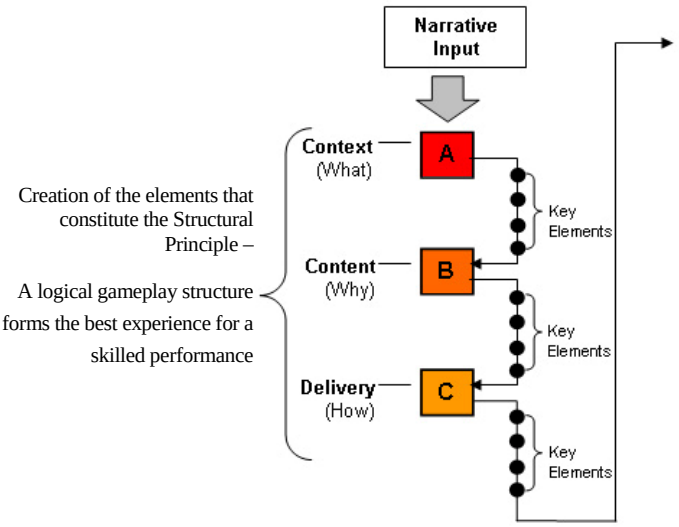

Figure 3: Narrative Input

Figure 4 the Narrative Progression tool is the visual representation of the Goal Principle – Any task that requires some skill has to aid you in the attainment of your goal. The primary function is to define the end goal of the gameplay narrative, enabling the designer to start the process of setting the narrative key-elements which will form the learning chain of skills and tasks.

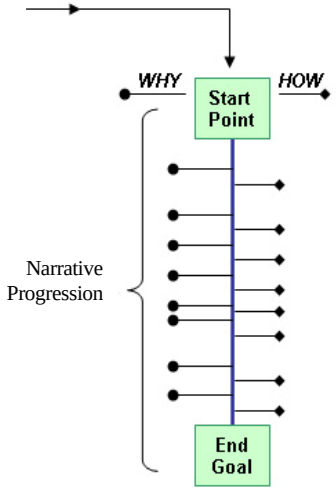

Figure 4: Narrative Progression tool

The Narrative Progression tool deals with 'Narrative Events' in the form of Why & How. The Why events are 'Progression events' these are key-events in the narrative which progress the player towards the end goal. The How is a 'Component Event' dealing with how the 'Progression event' will be delivered in gameplay form. Progression and Component events should be paired together forming a logical ladder of skills & tasks progressing the player

towards the end-goal. It is when these pairings are not sequential or are not paired logically that the playability design begins to breakdown. The information generated in the Progression revision section is passed into the 'Skill Phases' section, (Figure 5) where the gameplay component events are explored within the framework of the phases of skill learning.

This section of the model lays the 'component events' of the gameplay structure along the narrative progression line, the component events should have a skill and task level that is in relation to the skill phase that the player could expect to be in at this event. This process is governed by the Clarity and Comparison principles.

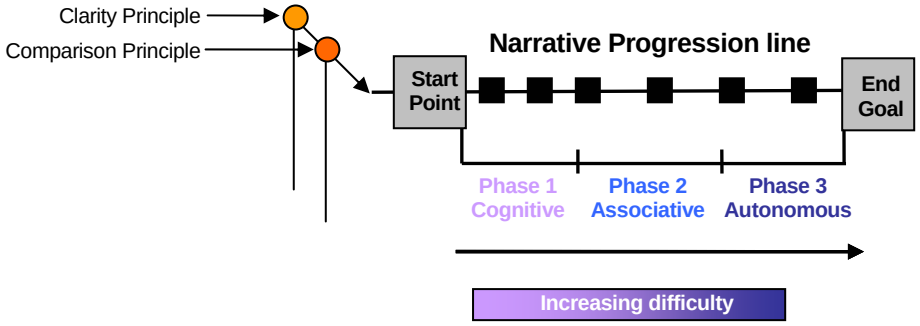

Figure 5: Skill Phases Section

In Figure 6, Stage 2 – Gameplay, this process is broken-down into exploration of the skills and tasks required for each element of gameplay throughout each in-game level.

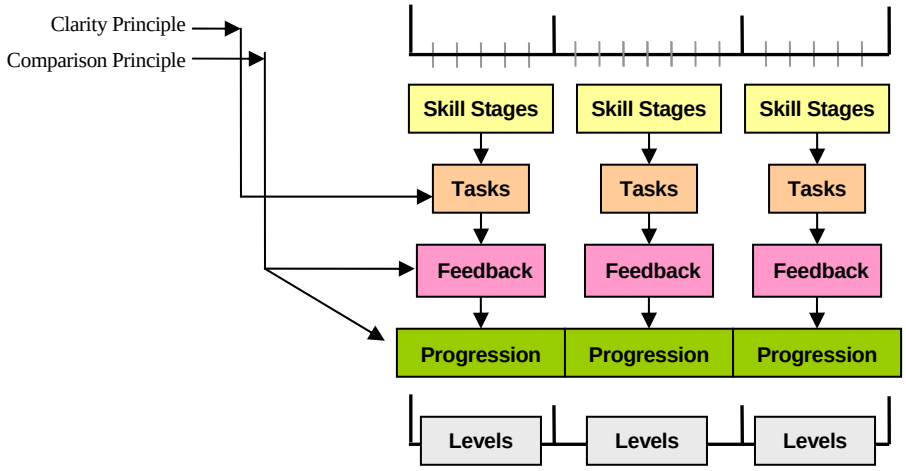

Figure 6: Stage 2 - Gameplay

Each level within a Phase of skill learning is made up of skill stages, each one designed to progress the player/learner onto the next stage until the end goal is acquired. Each task within the skill stage is governed by 'Clarity Principle; *Make the goal clear to your player from the start of the task, so they can understand why they are undertaking the task.* It is the role of the designer to give clear in-game instruction to the player allowing them to get the most from undertaking the task and learning outcome.

Comparison Principle; *The player needs a (visual or tactile) response to their actions to be able to compare how well they are progressing in relation to the desired outcome or alternatively the player needs to know how their actions have progressed them in the attainment of their goal,* governs the giving of feedback and the player progression path.

Broken down this way a game can be designed to support the learning experience of any player. By understanding our psychological approach to learning environments we can

design effective opportunities for the player to meet their potential within that environment. Although there are many factors that can influence the function of the interactive learning environment outside of any designer's control, having a system for the planning of an effective learning environment should go someway to enhancing the learning and playing experience of the end-user.

4 Evaluation and benefits of the model

Our initial hypothesis at the beginning of the paper was that the Structural Playability Design model was devised as a way to visually represent the psychological process of learning gameplay to an audience of game developers in a way that they could equate to their own working practices. In the formation of the model we created a 9 level playable demonstration game entitled 'Rasputin'. By applying the playability principles & phases of skill learning through a string of skills and tasks, we were able to show that it was possible to design gameplay using this method. In addition work has begun on further evaluation of the model with Team 17, creators of the successful series of 'Worms' games. Initial responses to the model have been favourable. Key comments being that they already undertook the playability processes described by the model but without formal recognition of what those processes mean to their playability design. The Why & How section of the progression revision model was recognised as a part of their design process for 'missions'. We were given examples of these to study in the form of tutorial levels for 'Worms3D' (2004) & 'Worms 4: Mayhem' (2005). This work is still continuing and will form the basis of a follow-up paper. Key elements of the Structural Playability Design model currently function within our undergraduate teaching. This includes an undergraduate teaching module which further explores the link between narrative progression and concept development. Also application of the playability principles framework directly in teaching game design students about goal directed gameplay structuring in level-design.

At the start of this paper I put forward the argument that '*designing computer game 'playability' by applying psychological principles can enhance the enjoyment and effectiveness of the player experience, while aiding the game developer in the design process'*. Salen & Zimmerman (2004), when describing games as the play of experience, summarize that "Game Design is a second-order design problem. A game designer only indirectly designs the player's experience, by *directly* designing the rules. Creating meaningful experiences means understanding the ways a game's formal system transforms into an experiential one." This statement implies an opening in game development for models that increase that understanding of how formal systems can be transformed into experiential ones. Which I believe the Structural Playability Design model begins to explore experiential game design by drawing upon our psychological predisposition as human beings to make sense of our environment through learning.

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