Reflexes and Their Role in Movement
Paul Harris, OD

OPSIS

1

Reflexes – The Building Blocks of Movement

Definitions for "reflex"

- Oxford – noun: an action that is performed as a response to a stimulus and without conscious thought; "a newborn baby is equipped with basic reflexes".

- Oxford – adjective: (of an action) performed without conscious thought as an automatic response to a stimulus; "sneezing is a reflex action".

OPSIS

2

Reflexes – The Building Blocks of Movement

Definition for "reflex"

- Merriam-Webster - an automatic and often inborn response to a stimulus that typically involves a nerve impulse passing inward from a receptor to the spinal cord and then passing outward from the spinal cord to an effector (such as a muscle or gland) without reaching the level of consciousness and often without passing to the brain.

OPSIS

3

How many reflexes are there?

- It depends…
- A list from Wikipedia shows 59 of these.
  - From: Abdominal, accommodation, acoustic… to withdrawal, yawn.
  - Four of these are identified as "primitive".
    - Asymmetric tonic neck
    - Galant
    - Moro
    - Sucking
  - In a supplemental list 9 of these are listed as "primitive".

OPSIS

4

Primitive Reflex – Supplemental List

1. Galant
2. Gastrocolic
3. Grasp
4. Moro
5. Rooting
6. Stepping
7. Sucking
8. Tonic Neck
9. Parachute

OPSIS

5

Reflexes Addressed in the OPSIS Course

- Tonic Labyrinthine Reflex (TLR)
- Asymmetrical Tonic Neck Reflex (ATNR)
- Spinal Galant (SG)
- Symmetrical Tonic Neck Reflex (STNR)
- Fear Paralysis Reflex
- Moro Reflex
- Grasp reflexes - Palmar

Source is Caroline Hurst

OPSIS

6

A peek ahead

What functions do reflexes serve during human locomotion?

E P Zehr [1], R B Stein

Abstract of the abstract:

- Studies on the reflex modulation of vertebrate locomotion have been conducted in many different laboratories and with many different preparations.

- Emerging concepts are that reflexes are task-, phase- and context-dependent. To function usefully in a behavior such as locomotion wherein initial conditions change from step to step, reflexes would have to show modulation.

- A framework is developed in which the modulation and flexibility of reflexes are demonstrated. Reflexes are shown to have important regulatory functions during human locomotion.

- The function of a given reflex pathway changes dynamically throughout the locomotor cycle.

- **While all reflexes act in concert to a certain extent**, generally cutaneous reflexes act to alter swing limb trajectory to avoid stumbling and falling. Stretch reflexes act to stabilize limb trajectory and assist force production during stance. Load receptor reflexes are shown to have an effect on both stance phase body weight support and step cycle timing.

- After neurotrauma or in disease, reflexes no longer function as during normal locomotion, but still have the potential to be clinically exploited in gait modification regimens.

OPSIS

7

OK but how do we get there?

- At first my mind went to early experiences with recursion and/or object-oriented programming.

- Recursion: In computer science, recursion is a method of solving a computational problem where the solution depends on solutions to smaller instances of the same problem. Recursion solves such recursive problems by using functions that call themselves from within their own code.

OPSIS

8

Tower of Hanoi – for 4 disks

OPSIS
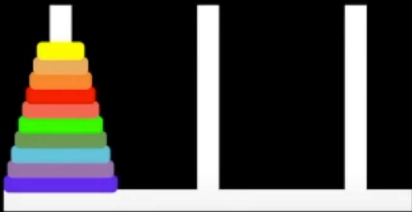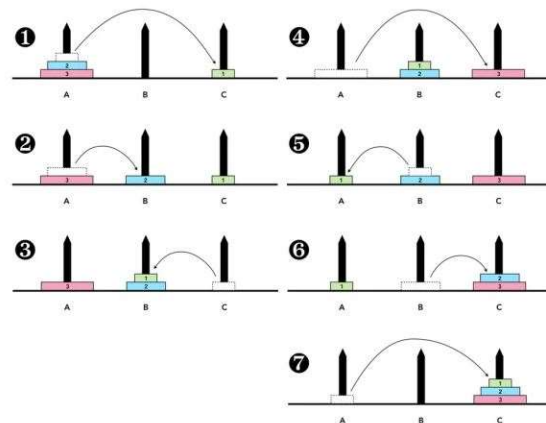
9

Tower of Hanoi With Music Pitches

https://www.youtube.com/watch?v=PGuRmqpr6Oo

OPSIS

10

General Equation for any Number of Disks

OPSIS

11

Object-Oriented Programming

- Wikipedia: "Object-oriented programming is a programming paradigm based on the concept of objects, which can contain data and code: data in the form of fields, and code in the form of procedures. In OOP, computer programs are designed by making them out of objects that interact with one another."
- More practical:
  - This term was coined by Alan Kay way back around 1966 when he was at graduate school.
  - The idea behind OOP was to put mini-computers in software that can communicate via message passing rather than through direct data sharing. This idea stops the breakdown of programs into different data structures and procedures.

APOLLO TECHNICAL
ENGINEERED TALENT SOLUTIONS

OPSIS

12

- A technical definition of the term would be that OOP is a computer programming school of thought or model that organizes software design around data or objects. This is contrary to the route of using functions and logic.

OOPs (Object-Oriented Programming System)

- When it comes to object-oriented programming, it puts great significance in organizing your code into objects that model the parts of your problem. These objects hold together the vital variables for describing each possible state of your model's component.

- This way of programming is excellent for big, complex, and actively updated programs. These programs could be used for design, manufacturing, developing mobile applications, and many more.

- To put it simply and convert everything as a one-liner, object-oriented programming was created to organize the complexity of procedural codebases.

OPSIS

13

OOPs (Object-Oriented Programming System)
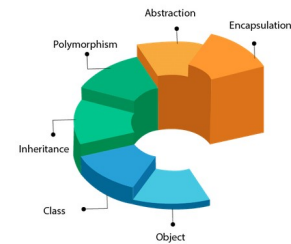
4 Main Blocks of OOP

- **Classes** – This is a blueprint for creating objects; it provides initial value for states and implementations of behavior. The class defines the nature of a future object. You can interpret class as a concept while the object is the reality or the embodiment of that concept.

- **Objects** – An object is a data field with unique attributes and behavior. These are instances of a class created with certain data. Objects have the flexibility to correspond to real-world objects or abstract entities.

- **Methods** – This defines the behavior of the objects created from the class. Method is an action that an object is able to perform. These are functions defined in a class that describes what the object will do.

- **Attributes** – These are the characteristics of the class that aids in separating it from other classes. It is what makes them unique and identifiable

OPSIS
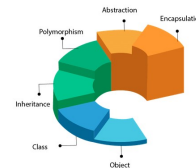
14

Five Advantages of OOP

Modularity	Reusability	Increased Productivity and Efficiency

Problem-Solving	Polymorphism Flexibility

OPSIS

15

Modularity

- Pieces of code are separate modules.
- When something goes wrong or needs modification, it is easy to isolate the module that needs "attention".
- Encapsulation allows objects to be self-contained, the process of both troubleshooting and collaborative development is easier and smooth.

OPSIS

16

Reusability

- When using OOP in your code work, your written codes can be reused through inheritance. This means that a team member doesn't need to repeat the process of writing the same code multiple times.

- Additionally, if you want to change all objects, just change your class, and all objects will inherit the new code. Being able to achieve these things, data redundancy is one of the best advantages that OOP gives to its users.

OPSIS

17

Increased Productivity and Efficiency

- With the advantage of creating new programs with ease and the ability to use reusable code, this makes programmers more productive and efficient. This process of organizing code efficiently allows for more tasks to be done and gives more time to produce quality outcomes.

- A programmer who adheres to OOP can also use new software objects to make completely new programs. This particular action can be done by taking advantage of libraries with useful functions.

OPSIS

18

Problem-Solving

- Handling a complex set of problems and turning them into smaller chunks is a practice displayed in OOP.
- In this paradigm, you break down your software code into smaller chunks. Then these chunks can be reused in solutions to various complex and simple problems.
- They too can be replaced by future modules that relate to the same interface with implementation details.

OPSIS

19

Polymorphism Flexibility

Polymorphism, by definition, means the ability of an object to take on many forms. When used in OOP, it is the concept that you can access objects of different types through the same interface. This enables a single function to adapt to the class it is placed in.
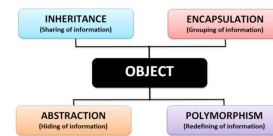
OPSIS

20

What Makes OOP Programming Unique?

Inheritance: The structure of classes is done through hierarchies, and inheritance allows the overall model and methods in one class to trickle down the hierarchy. Less programming is needed when adding functions to complex systems.
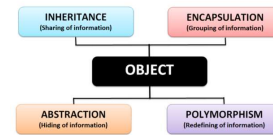

OPSIS
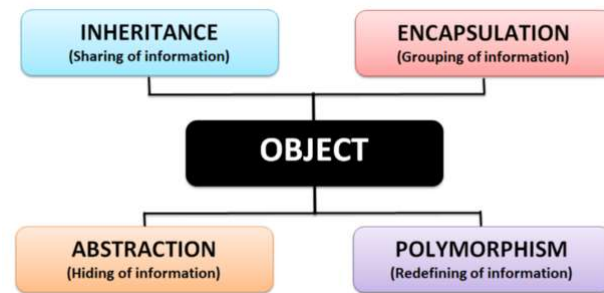
21

What Makes OOP Unique?

- Encapsulation in OOP means bundling data with the methods that operate on the said data.
- Encapsulation binds the class members together and prevents them from accessing other classes.
- Encapsulation protects the integrity of the code. This makes the code safer and more reliable.

OPSIS

22

What Makes OOP Unique?

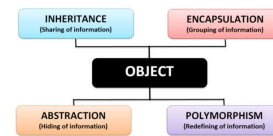| INHERITANCE (Sharing of information)	ENCAPSULATION (Grouping of information)
	OBJECT
ABSTRACTION (Hiding of information)	POLYMORPHISM (Redefining of information)

- Polymorphism: one object can take multiple forms in various instances. Example: the same person can possess different behaviors and traits which they use in different situations as needed.
- ASIDE: think of the ability to rotate the body around the vertical axis with the feet planted as in hitting a golf ball, which then can be morphed into throwing a ball or swinging a bat or an axe or…
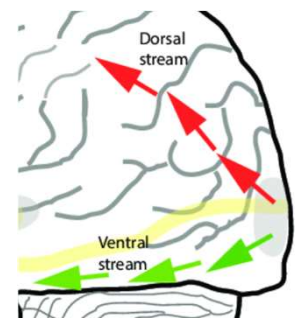
OPSIS

23

What Makes OOP Unique?

INHERITANCE (Sharing of information)	ENCAPSULATION (Grouping of information)
	OBJECT
ABSTRACTION (Hiding of information)	POLYMORPHISM (Redefining of information)

- **Abstraction** means to hide away the implementation details inside something. It should only show operations relevant to other objects. This means you don't have to deeply understand every function you use.
- ASIDE: Think here of the separation Milner and Goodale make in the roles of the Dorsal and Ventral streams.
  - Ventral – come up with the goals for action (conscious)
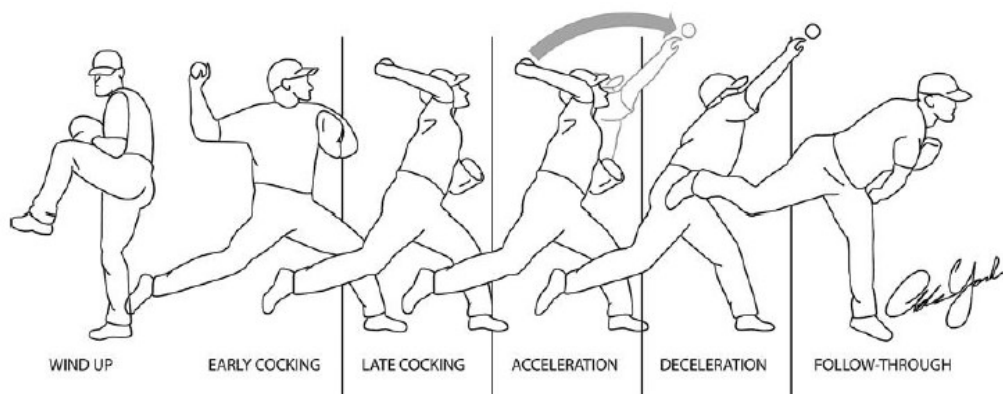 - Dorsal – execute the movements needed (unconscious)

OPSIS

24
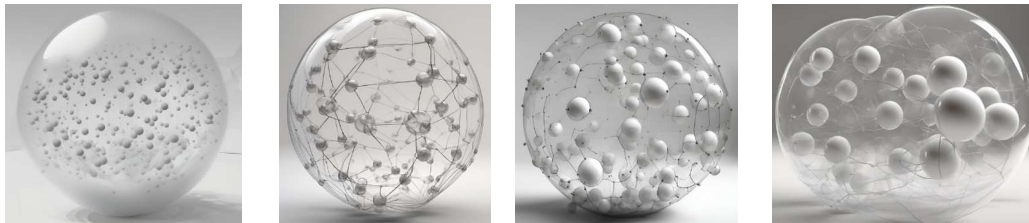
Let's put it all together

The Five Phases of Throwing a Ball

WIND UP   EARLY COCKING   LATE COCKING   ACCELERATION   DECELERATION   FOLLOW-THROUGH

ACE Physical Therapy & Sports Medicine Institute

The 8 Fundamentals of Pitching – Drew Johnson

1. Grip
2. Arm Angle
3. The Windup
4. The Pivot
5. The Leg Lift
6. The Stride
7. The Delivery
8. The Follow-Through

OPSIS

27

Golf Swing from Parts to Whole

OPSIS

28

Golf Swing

Golf Distillery

OPSIS

29

Back to the Reflexes

- They are the fundamental building blocks of movement.
- They are the "objects" of all movement(s).
- As such, they are all available all the time.
- Should life provide a requirement for the development of a new movement, the problem-solving abilities of the person, to be successful, will search to a point as close to the base objects as is needed to develop the required movement.
- Once developed it can then be modified and embellished or morphed into a multitude of variants as needed to solve life's demands.

OPSIS

30

Conclusion

- All work we do to help a person perform better in the world works because of their ability to use the multitude of objects and classes they have developed.
- Reflexes, be they primitive or otherwise are a part of what we all do all the time.

OPSIS

31

Questions for the Group

- The role of reflexes is to provide a basis for motor development. If that is so, how is this done?

- Behavioral vision care enables learning and sets the stage for learning to learn. All learning is motor learning and is driven by images of accomplishment. Why then does treatment in this area seem to have to regularly go back to the foundations for extended periods of time?

OPSIS

32

Thank you and Q&A

Paul Harris, OD

Retired Professor, Southern College of Optometry

1376 Cedar Run Cove

Cordova, TN 38016

Paul.HarrisOD@gmail.com

OPSIS

33