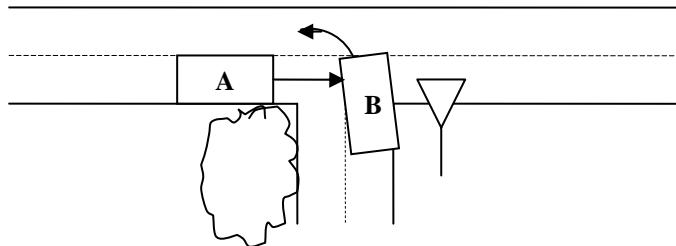


## 6. EXAMPLE ACCIDENTS

Some of the examples below are inspired by accidents described by Englund, Jarleryd, Lindkvist and Pettersson (1978).

### Scenario 1 (intersection accident)



#### Driver A

A is on her way home and is driving on a priority road, approaching a T-junction (approximately 200 meters away from her house) in 45-50 km/h (speed limit 50 km/h). A is planning to continue straight ahead in the intersection and states that there is no other traffic around. When A discovers B the vehicles are so close to each other that A does not have time to brake or to make an avoidance manoeuvre before A drives into B's left side. A states that she is well aware that the intersection is dangerous and that she has experienced several incidents there. A also states that she is very familiar with the road which makes it easy for her to forget to adapt the speed.

Driver: 38-year old woman (has had a driving licence for 20 years), was not tired or distracted, was not under the influence of alcohol, drugs or medication, does, however, state that she is so familiar with the intersection that her level of attention was low

Vehicle: Peugeot in good condition

Traffic environment: T-intersection where vehicles on the connecting road should give way, the view is obstructed by a 1.6 meter high hedge in a garden, speed limit is 50 km/h

#### Driver B

Just before the intersection B has stopped to look at a house and therefore she is approaching the intersection in a low speed (35-40 km/h). B notices the sign telling her to give way. There are no other road users around. B stops before the dotted white line painted on the tarmac in her lane. B looks to the right and to the left but does not see any vehicles approaching and therefore she drives into the intersection. Suddenly A appears from the left and drives into B's side. There are no brake marks in the intersection.

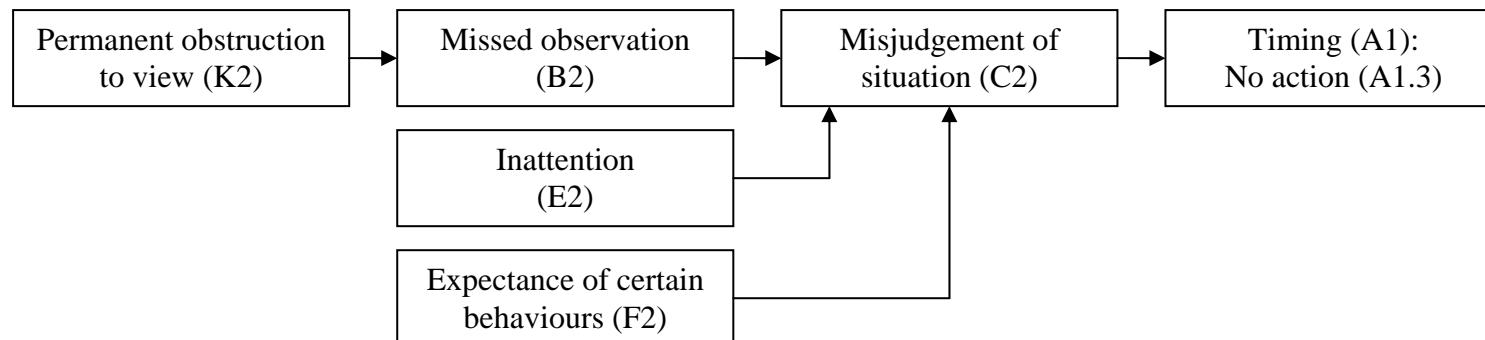
Driver: 36-year old woman (has had an African driving licence for 15 years and a Swedish driving licence for 10 years), was not in a hurry

Vehicle: Volvo in good condition which she has had for 6 months

Traffic environment: connecting road in T-junction, should give way which is signposted as well as marked with a dotted white line painted on the tarmac, the view is obstructed by a 1.6 meter tall hedge in a garden – to get a free view in the intersection it is necessary to stop after the dotted line.

*Scenario 1 (intersection accident)*

Driver A



The phenotype is chosen when A enters the intersection even though B is approaching. As A enters the intersection without doing anything (e.g. does not brake in order to avoid entering the intersection before it is free) the phenotype *timing: no action* is chosen.

The cause behind A entering the intersection before it is free is that A misjudges the situation and thinks the intersection is free and safe to enter. Therefore the genotype *misjudgement of situation* is chosen.

There are three different factors contributing to A's misjudgement of the situation.

Firstly, A states that there is no other traffic around which implies that A does not see B approaching and therefore the genotype *missed observation* is chosen. The missed observation is caused by the hedge blocking A's view and therefore the genotype *permanent obstruction to view* is chosen.

This accident-chain then stops in accordance with stop rule number 2:

*If there exists no general or specific genotypes that link to the chosen consequent, the analysis stops.*

The second factor contributing to A's misjudgement of the situation is that, according to A, her attention is low as she is very familiar with the road. Therefore the genotype *inattention* is chosen.

This accident-chain then stops in accordance with stop rule number 3:

*If none of the available general or specific genotypes for the chosen consequent is relevant, given the information available about the accident, the analysis stops.*

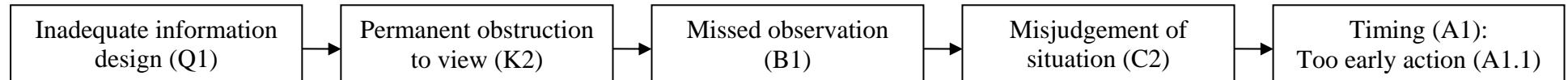
The third factor contributing to A's misjudgement of the situation is that A drives on a priority road and therefore it is reasonable to assume that A expects crossing traffic to give way in accordance with the give way sign. Therefore the genotype *expectance of certain behaviours* is chosen.

This accident-chain then stops in accordance with stop rule number 2:

*If there exists no general or specific genotypes that link to the chosen consequent, the analysis stops.*

*Scenario 1 (intersection accident)*

Driver B



The phenotype is chosen when B passes the give way sign even though A is approaching the intersection. As B enters the intersection before A has safely passed, the phenotype *timing: too early action* is chosen.

The cause behind B entering the intersection before it is free is that B misjudges the situation and thinks the intersection is free and safe to enter. Therefore the genotype *misjudgement of situation* is chosen.

B's misjudgement of the situation is caused by B not seeing A approaching. Therefore the genotype *missed observation* is chosen.

B not seeing A approaching is caused by the hedge blocking B's view. Therefore the genotype *permanent obstruction to view* is chosen.

B's view being blocked by the hedge is caused by the give way line painted on the tarmac being placed too far back in the intersection, making it impossible to see vehicles approaching from the left when stopping before the line. Therefore the genotype *inadequate information design* is chosen.

This accident-chain then stops in accordance with stop rule number 2:

*If there exists no general or specific genotypes that link to the chosen consequent, the analysis stops.*

*Scenario 2 (catching up accident)*

---



A still standing car queue has formed and vehicle 1 (which stands still) is last in this queue.

**Driver A**

A is driving in 50 km/h on a busy street. A is talking with her daughter who sits next to her in the front passenger seat. Suddenly the daughter says that the car in front of them has stopped. A brakes very hard and stops the car at least 10 meters behind the still standing car (position 1). A few seconds later, A is hit from behind by B.

Driver: 58-year old woman (has had a driving licence for 40 years), has previously been involved in an accident where she was hit from behind resulting in her getting a whip-lash injury, stats that she panicked when she, completely unprepared, found herself in the same kind of situation again, was not tired, was not under the influence of alcohol, drugs or medication

Vehicle: Toyota in good condition

Traffic environment: Busy city-street with a 50 km/h speed limit

**Driver B**

B is in a hurry to get to work and is driving 55-60 km/h on a busy street with a 50 km/h speed limit. Suddenly B sees A braking very hard. B brakes as hard as she can but still drives into A's rear end.

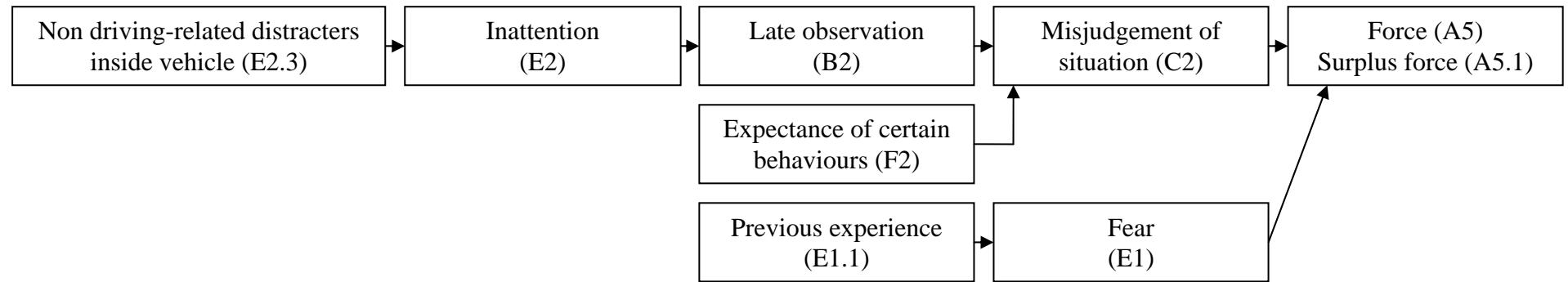
Driver: 25-year old woman (has had a driving licence for 5 years), was not tired or distracted, was not under the influence of alcohol, drugs or medication

Vehicle: Opel in good condition

Traffic environment: Busy city-street with a 50 km/h speed limit

*Scenario 2 (catching up accident)*

Driver A



The phenotype is chosen when A suddenly brakes very hard. As A brakes unnecessarily hard (stopping 10 meters behind the queue) the phenotype *force: surplus force* is chosen.

There are two factors contributing to A braking so hard.

Firstly, A panics and therefore the genotype *fear* is chosen.

A's panic is caused by the fact that A, in the past, has been involved in a similar situation resulting in A getting a whiplash injury. Therefore the specific genotype *previous experience* is chosen.

This accident-chain then stops in accordance with stop rule number 1:

*Specific genotypes have the status of terminal events. Therefore, if a specific genotype is the most likely cause of a general consequent, that genotype is chosen and the analysis stops.*

The second factor contributing to A braking so hard is that A misjudges the situation thinking that braking really hard is the safest way of avoiding an accident. Therefore the genotype *misjudgement of situation* is chosen.

There are two factors contributing to A's misjudgement of the situation.

Firstly, A is not prepared for the situation as she does not expect cars in her lane to slow down and therefore the genotype *expectance of certain behaviours* is chosen.

This accident-chain then stops in accordance with stop rule number 2:

*If there exists no general or specific genotypes that link to the chosen consequent, the analysis stops.*

The second factor contributing to A's misjudgement of the situation is that A does not see the car queue until her daughter informs her about it at which time it is too late for A to properly judge the situation and brake smoothly. Therefore the genotype *late observation* is chosen.

A's late observation is caused by her not focusing her attention on the road in front of her (if she had done she would have reacted to the car queue before her daughter informed her of it). Therefore the genotype inattention is chosen.

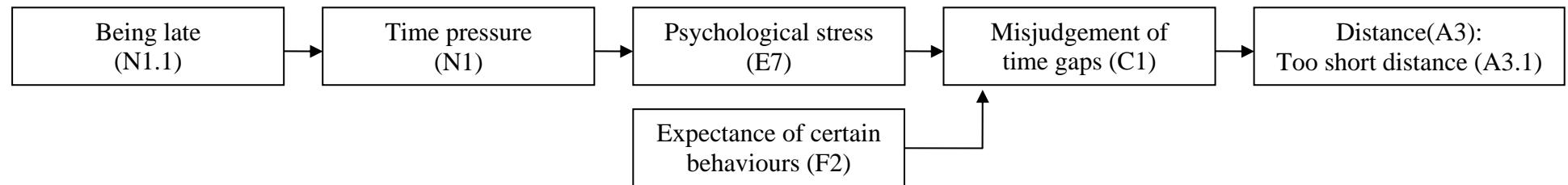
A's inattention is caused by her talking to her daughter. Therefore the specific genotype *non driving-related distracters inside vehicle* is chosen.

This accident-chain then stops in accordance with stop rule number 1:

*Specific genotypes have the status of terminal events. Therefore, if a specific genotype is the most likely cause of a general consequent, that genotype is chosen and the analysis stops.*

*Scenario 2 (catching up accident)*

Driver B



The phenotype is chosen when there is no longer any time/space left for B to act in order to avoid the accident. As B cannot avoid driving into A even though she brakes as hard as she can as soon as A starts braking, the phenotype *distance: too short distance* is chosen.

The cause behind B starting to brake too late is that B misjudges the time gap needed to the car in front (A) at the speed she is travelling. Therefore the genotype *misjudgement of time gaps* is chosen.

There are two factors contributing to B's misjudgement of the time gap.

Firstly, B does not expect A to suddenly brake so hard and therefore the genotype *expectance of certain behaviours* is chosen.

This accident-chain then stops in accordance with stop rule number 2:

*If there exists no general or specific genotypes that link to the chosen consequent, the analysis stops.*

The second factor contributing to B's misjudgement of the time gap is that B is stressed. Therefore the genotype *psychological stress* is chosen.

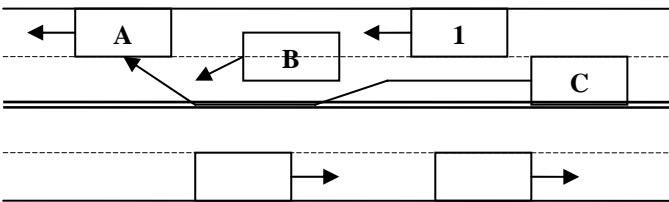
B being stressed is caused by time pressure. Therefore the genotype *time pressure* is chosen.

B experiencing time pressure is caused by her being late for work. Therefore the specific genotype *being late* is chosen.

This accident-chain then stops in accordance with stop rule number 1:

*Specific genotypes have the status of terminal events. Therefore, if a specific genotype is the most likely cause of a general consequent, that genotype is chosen and the analysis stops.*

### Scenario 3 (leaving lane accident)



#### Driver A

A is driving on a motorway with a 110 km/h speed limit. It is late afternoon and A has just picked up his car at a garage where the chassis had been coated to resist rust. To avoid getting dust and dirt in the new coating A drives with a top speed of 50 km/h (which is also supported by other evidence at the scene). A drives as far to the right as he can, without crossing the white line painted on the tarmac. Suddenly – completely unexpected – A's left side is hit by C. A loses control over the car and drives down a slope to the right of the road. A stops against a bank of soil. Straight after the accident A does not understand what really happened.

Driver: 38-year old man (has had a driving licence for 20 years), was not tired or distracted, was not under the influence of alcohol, drugs or medication

Vehicle: Volvo in good condition

Traffic environment: Motorway with a 110 km/h speed limit, late afternoon with dark but clear weather

#### Driver B

B is driving 100-110 km/h when he approaches a vehicle which he judges to drive approximately 80 km/h. In the rear mirrors B sees the head lights from a vehicle behind him. B does, however, judge the vehicle to be so far behind that he can start to overtake the slow vehicle in front of him. B cannot recall that there was any vehicle right behind him (position 1). B indicates to change lane and starts the overtaking. Suddenly, B sees C cut in front of him and drive into the left side of A. B brakes and stops his car at the road side.

Driver: 29-year old man (has had a driving licence for 10 years), was not in a hurry or distracted but has, during the previous week, slept worse than normal because of night duty, was not under the influence of alcohol, drugs or medication

Vehicle: Opel in good condition

Traffic environment: Motorway with a 110 km/h speed limit, late afternoon with dark but clear weather

#### Driver C

C is driving 100-110 km/h when he discovers a car queue in front of him. C judges the queue to drive quite fast – but slower than him. C changes to the left lane in order to overtake the queue. Suddenly B pulls out in front of C in the left lane. C has not seen B indicate to change lane and judges the distance to B to be between three to four car lengths. C judges it being impossible to slow down enough not to drive into the rear end of B and therefore he overtakes B by using the left shoulder. When C has nearly passed B he gets a skid and loses control over the car. C cuts in front of B and drives into A's left side. C then manages to stop his car on the right shoulder.

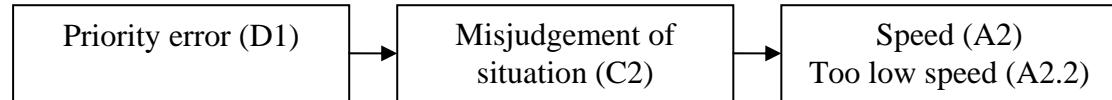
Driver: 66-year old man (has had a driving licence for 48 years), was not tired or distracted, was not under the influence of alcohol, drugs or medication

Vehicle: Ford in good condition which he has had as a company car – before that he had another car of the same brand

Traffic environment: Motorway with a 110 km/h speed limit, late afternoon with dark but clear weather

*Scenario 3 (leaving lane accident)*

Driver A



The phenotype is chosen when A decides to drive in 50 km/h on a motorway with a 110 km/h speed limit. As A drives slower than what can be expected by other drivers the phenotype *speed: too low speed* is chosen.

The cause behind A driving so slow is that A misjudges the situation thinking it is safe to drive 50 km/h on a motorway with a 110 km/h speed limit. Therefore the genotype *misjudgement of situation* is chosen.

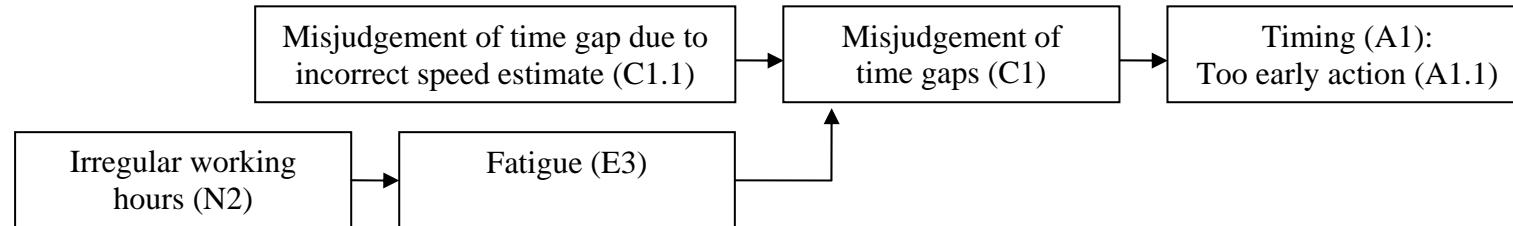
A's misjudgement of the situation is caused by him choosing to drive slowly to protect his new coating on the chassis rather than keeping to the traffic rhythm – as he thinks both options are safe. Therefore the genotype *priority error* is chosen.

This accident-chain then stops in accordance with stop rule number 3:

*If none of the available general or specific genotypes for the chosen consequent is relevant, given the information available about the accident, the analysis stops.*

*Scenario 3 (leaving lane accident)*

Driver B



The phenotype is chosen when B leaves his own lane in order to overtake A. As B enters the lane next to him before C has safely passed the phenotype *timing: too early action* is chosen.

The cause behind B leaving his lane too early is that he misjudged the gap to C approaching from behind. Therefore the genotype *misjudgement of time gaps* is chosen.

There are two factors contributing to B's misjudgement of the time gap.

Firstly, B underestimates the time gap available until C will reach him (which is easily done when looking in the rear mirror) and therefore the specific genotype *misjudgement of time gap due to incorrect speed estimate* is chosen.

This accident-chain then stops in accordance with stop rule number 1:

*Specific genotypes have the status of terminal events. Therefore, if a specific genotype is the most likely cause of a general consequent, that genotype is chosen and the analysis stops.*

The second factor contributing to B's misjudgement of the time gap is that B is tired after having slept worse than normal. Therefore the genotype *fatigue* is chosen.

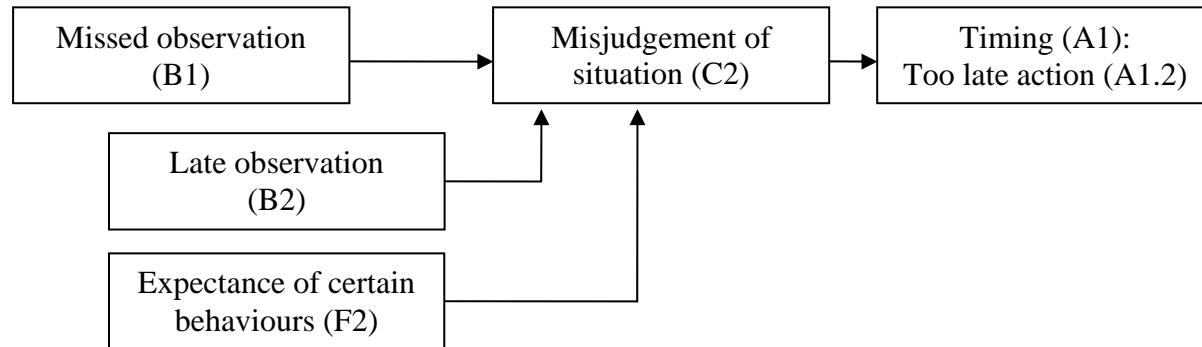
B having slept worse than normal is caused by him having night duty. Therefore the genotype *irregular working hours* is chosen.

This accident-chain then stops in accordance with stop rule number 2:

*If there exists no general or specific genotypes that link to the chosen consequent, the analysis stops.*

*Scenario 3 (leaving lane accident)*

Driver C



The phenotype is chosen when, there is no longer any time/space left for C to act in order to avoid the accident. As B reacts too late to avoid an accident, the phenotype *timing: too late action* is chosen.

The cause behind reacting too late is that C thought it was safe to pass the car queue. Therefore the genotype *misjudgement of situation* is chosen.

There are three factors contributing to C's misjudgement of situation.

Firstly, C does not see B indicating to change lane and therefore the genotype *missed observation* is chosen.

This accident-chain then stops in accordance with stop rule number 3:

*If none of the available general or specific genotypes for the chosen consequent is relevant, given the information available about the accident, the analysis stops.*

The second factor contributing to C's misjudgement of the situation is that C suddenly sees B change lane - too late to avoid an accident. Therefore the genotype *late observation* is chosen.

This accident-chain then stops in accordance with stop rule number 3:

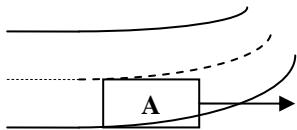
*If none of the available general or specific genotypes for the chosen consequent is relevant, given the information available about the accident, the analysis stops.*

The third factor contributing to C's misjudgement of the situation is that it is reasonable to assume that C does not expect B to suddenly change lane right in front of him. Therefore the genotype *expectance of certain behaviours* is chosen.

This accident-chain then stops in accordance with stop rule number 2:

*If there exists no general or specific genotypes that link to the chosen consequent, the analysis stops*

*Scenario 4:I (leaving lane accident)*



Driver A

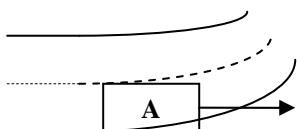
A is driving 130 km/h on a road with a 70 km/h speed limit (that the speed was high is also supported by other evidence at the scene). A is on his way to a party but states that he is not in much of a hurry. There are four passengers (males in the same age of the driver) in the car. When A enters a sharp curve he gets a skid. A tries to control the skid but fails. A ends up, upside down in a ditch.

Driver: 19-year old man (has had a driving licence for 1 year), was not tired and states that he was not distracted by his passengers, was not under the influence of alcohol, drugs or medication

Vehicle: Older Volvo in good condition

Traffic environment: Rural road in normal condition with a 70 km/h speed limit

*Scenario 4:II (leaving lane accident)*



Driver A

A is driving 130 km/h on a road with a 70 km/h speed limit (that the speed was high is also supported by other evidence at the scene). When A enters a sharp curve, which is incorrectly cambered and the surface is covered in gravel, he gets a skid. A tries to control the skid but fails. A ends up, upside down in a ditch.

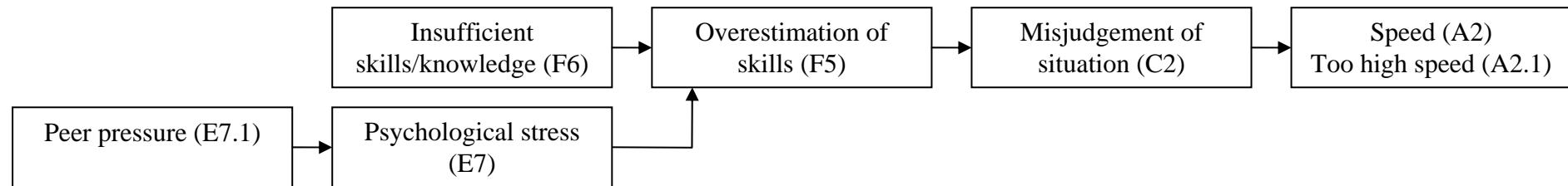
Driver: 19-year old man (has had a driving licence for 1 year), was not tired or distracted, was not under the influence of alcohol, drugs or medication

Vehicle: Older Volvo in good condition

Traffic environment: incorrectly cambered curve on a 70km/h-road. The surface in the curve was covered with gravel.

*Scenario 4:I (leaving lane accident)*

Driver A



The phenotype is chosen when A leaves his own lane. As A drives too fast to take the curve under the prevailing conditions, the phenotype *speed: too high speed* is chosen.

The cause behind A driving too fast is that A misjudges the situation thinking it is safe to enter the curve in that speed. Therefore the genotype *misjudgement of situation* is chosen.

A's misjudgement of the situation is caused by A overestimating his own skills thinking he can handle the car in that speed. Therefore the genotype *overestimation of skills* is chosen.

There are two factors contributing to A's overestimation of his own skills.

Firstly, A has only had his driving licence for one year and has not enough skills and knowledge in order to handle the situation safely and therefore the genotype *insufficient skills/knowledge* is chosen.

This accident-chain then stops in accordance with stop rule number 3:

*If none of the available general or specific genotypes for the chosen consequent is relevant, given the information available about the accident, the analysis stops.*

The second factor contributing to A's overestimation of his own skills is that A is stressed. Therefore the genotype *psychological stress* is chosen.

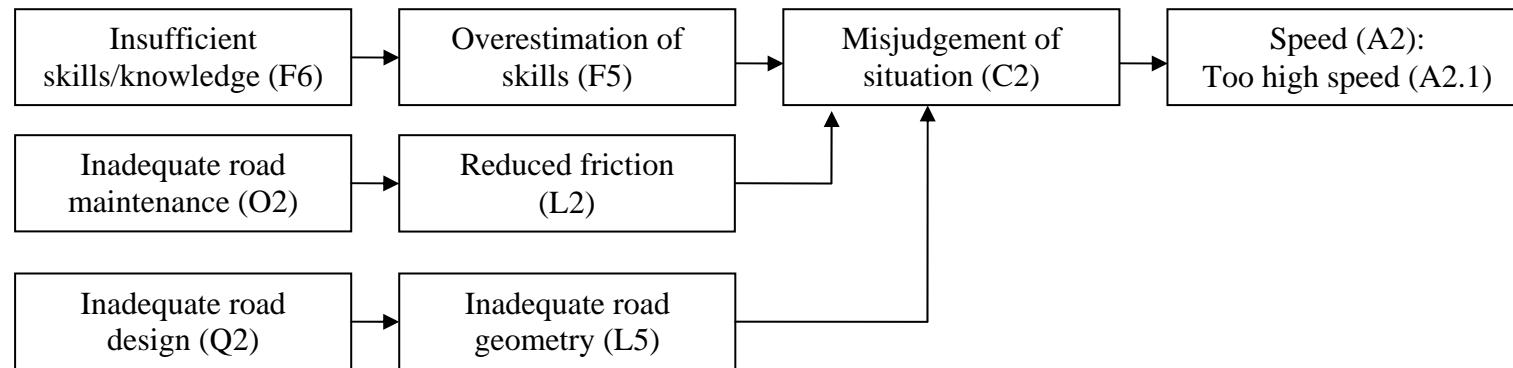
C's stress is caused by him having several male passengers in his own age. Therefore the specific genotype *peer pressure* is chosen.

This accident-chain then stops in accordance with stop rule number 1:

*Specific genotypes have the status of terminal events. Therefore, if a specific genotype is the most likely cause of a general consequent, that genotype is chosen and the analysis stops.*

*Scenario 4:II (leaving lane accident)*

Driver A



The phenotype is chosen when A leaves his own lane. As A drives too fast to take the curve under the prevailing conditions the phenotype *speed: too high speed* is chosen.

The cause behind A driving too fast is that A misjudges the situation thinking it is safe to enter the curve in that speed. Therefore the genotype *misjudgement of situation* is chosen.

There are three factors contributing to A's misjudgement of the situation.

Firstly, A overestimating his own skills thinking he can handle the car in that speed and therefore the genotype *overestimation of skills* is chosen.

A's overestimation of his own skills is caused by A only having had his driving licence for one year and therefore not having enough skills and experience in order to handle the situation safely. Therefore the genotype *insufficient skills/knowledge* is chosen.

This accident-chain then stops in accordance with stop rule number 3:

*If none of the available general or specific genotypes for the chosen consequent is relevant, given the information available about the accident, the analysis stops.*

The second factor contributing to A's misjudgement of the situation is the gravel covering the tarmac resulting in poor friction. Therefore the genotype *reduced friction* is chosen.

The reduced friction is caused by the fact that no one has removed the gravel from the road. Therefore the genotype *inadequate road maintenance* is chosen.

This accident-chain then stops in accordance with stop rule number 3:

*If none of the available general or specific genotypes for the chosen consequent is relevant, given the information available about the accident, the analysis stops.*

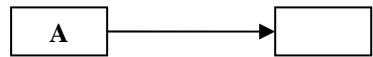
The third factor contributing to A's misjudgement of the situation is the curve being incorrectly cambered. Therefore the genotype *inadequate road geometry* is chosen.

The incorrect camber is caused by a poor road design. Therefore the genotype *inadequate road design* is chosen.

This accident-chain then stops in accordance with stop rule number 3:

*If none of the available general or specific genotypes for the chosen consequent is relevant, given the information available about the accident, the analysis stops.*

*Scenario 5 (unintended acceleration)*



Driver A

A has just been shopping and gets into the car to drive home. A starts the car to turn out of a narrow parking space. To lower (the already low) speed A presses the brake. Instead of slowing down the car accelerates and therefore A presses the brake pedal to the floor. According to A something must be wrong with the brake because when she presses it to the floor the speed quickly increases and A drives into a parked car. After the accident A steps out of the car and could be interviewed. Nothing suggests that A was ill or has had some kind of seizure.

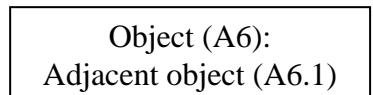
Driver: 67-year old woman (has had a driving licence for 45 years), was not tired or distracted, was not under the influence of alcohol, drugs or medication

Vehicle: Newer Toyota which she has had for 6 months, the vehicle has automatic gear change and is in good condition. No failures were found on the brake- and fuel-systems.

Traffic environment: Fairly narrow parking space

*Scenario 5 (unintentional acceleration)*

Driver A



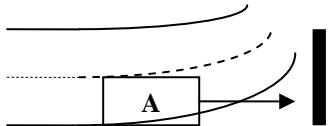
The phenotype is chosen when A presses the wrong pedal. As A presses the acceleration pedal, instead of the brake pedal, the phenotype *object: adjacent object* is chosen.

The analysis then stops in accordance with stop rule number 3:

*If none of the available general or specific genotypes for the chosen consequent is relevant, given the information available about the accident, the analysis stops.*

### *Scenario 6 (leaving lane accident)*

This example is based on an accident described by Leplat and Rasmussen (1987, p. 159).



Driver A

A is a lorry driver and is preparing a delivery. As A's usual lorry is at the garage he picks up a replacement lorry, which is unfamiliar to him. The borrowed lorry is somewhat smaller than the one A normally drives and its brake system has not been properly maintained (but A is unaware of this). The lorry is loaded with the cargo adapted to A's normal lorry which results in the borrowed lorry being somewhat overloaded. A leaves with his cargo but the route he normally takes is closed due to road repair. A takes a detour which turns out to have an unexpected long, steep and curvy slope downhill. A puts in a low gear and starts to brake. After a while A realises that the brakes are not working properly and the lorry catches speed. The speed is finally so high that the lorry continues straight ahead in a curve and hits a rock wall.

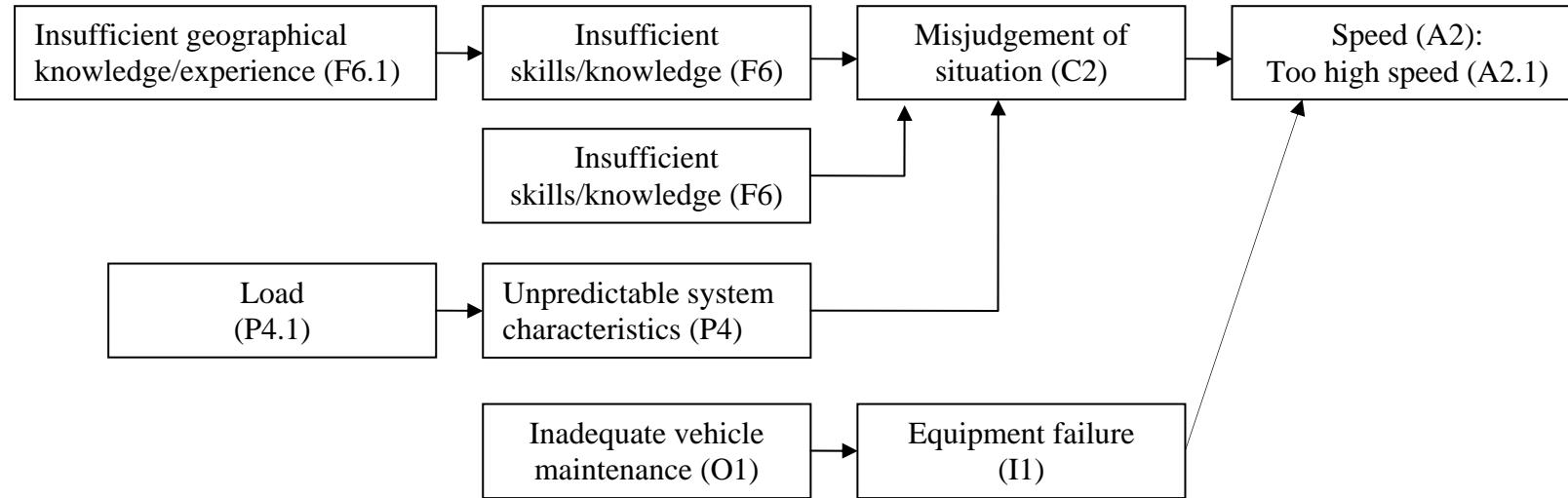
Driver 58-year old man (has been driving lorries for 38 years), was not tired or distracted, was not under the influence of alcohol, drugs or medication

Vehicle: Lorry with a badly maintained brake system

Traffic environment: Long, steep and curvy slope downhill.

*Scenario 6 (leaving lane accident)*

Driver A



The phenotype is chosen when A leaves his own lane. As A drives too fast to take the curve under the prevailing conditions the phenotype *speed: too high speed* is chosen.

There are two factors contributing to A entering the curve too fast.

Firstly, the brakes are not working properly and therefore the genotype *equipment failure* is chosen.

The equipment failure is caused by poor maintenance of the brakes. Therefore the genotype *inadequate vehicle maintenance* is chosen.

This accident-chain then stops in accordance with stop rule number 2:

*If there exists no general or specific genotypes that link to the chosen consequent, the analysis stops*

The second factor contributing to A entering the curve too fast is that A misjudges the situation thinking he could safely drive the chosen route. Therefore the genotype *misjudgement of situation* is chosen.

There are three factors contributing to A's misjudgement of the situation.

Firstly, A does not have enough knowledge about the chosen route and therefore the genotype *insufficient skills/knowledge* is chosen.

A's insufficient knowledge about the route is caused by insufficient knowledge and experience of the chosen route. Therefore the specific genotype *insufficient geographical knowledge/experience* is chosen.

This accident-chain then stops in accordance with stop rule number 1:

*Specific genotypes have the status of terminal events. Therefore, if a specific genotype is the most likely cause of a general consequent, that genotype is chosen and the analysis stops.*

The second factor contributing to A's misjudgement of the situation is that A does not have enough knowledge about the lorry he borrowed resulting in him overloading it and also not being aware of the fact that the brakes had been poorly maintained. Therefore the genotype *insufficient skills/knowledge* is chosen once more.

This accident-chain then stops in accordance with stop rule number 3:

*If none of the available general or specific genotypes for the chosen consequent is relevant, given the information available about the accident, the analysis stops.*

The third factor contributing to A's misjudgement of the situation is that the brakes do not work as he expects. Therefore the genotype *unpredictable vehicle characteristics* is chosen.

The brakes not working as expected are caused by the lorry being overloaded. Therefore the specific genotype *heavy load* is chosen.

This accident-chain then stops in accordance with stop rule number 1:

*Specific genotypes have the status of terminal events. Therefore, if a specific genotype is the most likely cause of a general consequent, that genotype is chosen and the analysis stops.*