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Multi-country study on preferred seating configuration & positions in fully automated vehicles for families

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Child Occupant Protection seminar: Latest knowledge & challenges in future mobility
Gothenburg, Sweden, September 4th 2019



BACKGROUND

FAV potential to revolutionise transport.

FAV may not require anyone to drive:

- Steering wheels, accelerators & brakes may either not be present or may only appear when required in special circumstances.

Driver = passenger with other FAV occupants,
& can engage in activities other than driving.



FAV interiors may prioritise occupant comfort, entertainment & interaction.

New seating configurations & positions possible within FAV - different to conventional seating configurations & positions (ie, with all seats forward-facing).

BACKGROUND

Current restraint systems rely on occupants being forward-facing & sitting upright for protection in majority of MVC types.

Accommodating flexible seating configurations & positions such as rotated &/or reclined seats will result in significant challenges in protecting occupants in event of a MVC.

- Studies confirmed conventional restraint systems do not provide adequate protection in new seating configurations (Forman et al, 2018; Kitagawa et al, 2017; Jin et al, 2018).



Several parameters may influence occupants' preferences for seating configurations & positions, including: trip purpose, trip length, & occupants with whom they are travelling.

BACKGROUND

Jorlov & colleagues (2017) asked Swedish Ps to position 4 seats within boundary of FAV space across different travelling scenarios.

- Shorter scenarios – Ps could expect to be alone - preferred forward-facing seating configuration, with possibility of reclined seating position.
- Longer scenarios - Ps could expect to be travelling with other occupants - preferred a 'living room' seating configuration (i.e., where occupants face each other).
- Ps also noted they would be willing to accommodate additional or alternative seatbelt configurations.



Current study aimed to conduct an online survey across multiple countries to understand:

- 1) Seating configuration & position preferences in a FAV across 7 hypothetical travelling scenarios;
- 2) Activities that they would engage in during travelling scenarios, &
- 3) Willingness to wear different seatbelt configurations while seated non-forward-facing or reclined?

METHOD

Participants

Eligible to participate if they were 18+ years.

Materials

Ps completed online survey (approx. 15 min), asked to imagine travelling in a FAV (i.e., where they select their final destination & do not need to drive) across 7 hypothetical travelling scenarios:

- 1) by themselves;
- 2) with partner/spouse;
- 3) with child occupant(s);
- 4) with partner/spouse & child occupant(s);
- 5) with older relative(s);
- 6) with partner/spouse & older relative(s);
- 7) with unknown occupant.

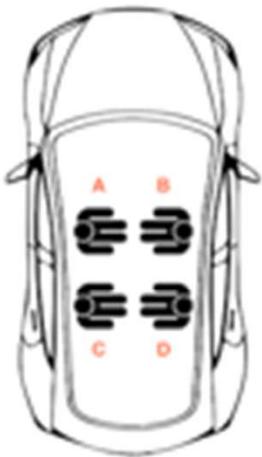


METHOD

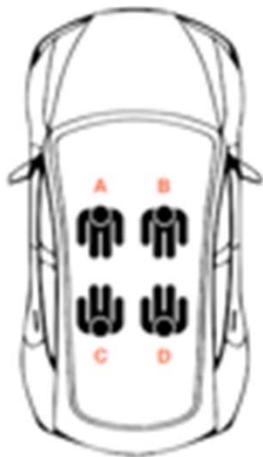
Materials

For each travelling scenario, Ps asked to select 1 of 5 seating configurations & 1 of 4 seating positions for themselves & any additional occupants (based on Jorlov et al, 2017).

- 'A' (driver, front left); 'B' (front seat passenger, front right); 'C' (rear left) & 'D' (rear right).
 - ✓ Seating position preferences for AUS & UK Ps transposed to reflect conventional driver position.



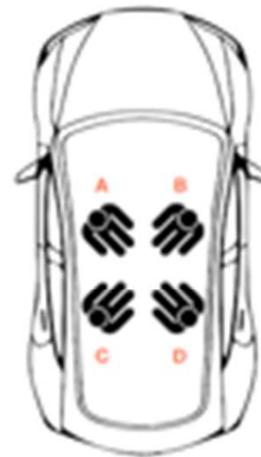
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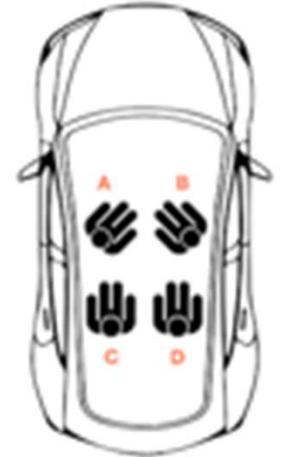
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METHOD

Materials

Ps asked:

- Demographic questions (eg, age, gender, weight, height), questions about road user experiences (eg, motor vehicle travel exposure, licensing history, etc), &
- Demographic questions about family members (eg, partner/spouse, children, etc) who regularly travel in a motor vehicle with them (eg, age, gender, height, weight).

Ps asked:

- Activities they, & any additional occupants, would engage in during travelling scenarios?
- Willing to wear different seatbelt while seated in non forward-facing mode or while reclined?

Procedure

Study approved by Institutional ethics committees.

Ps recruited through online & social media advertising:

- University & Organisation newsletters, Facebook pages, Twitter & LinkedIn feeds, etc.

Survey administered from Nov 2018 – Feb 2019.



*Used with permission from
Östling et al., 2018*

RESULTS

522 Ps (M=36.6 years, SD=14.0 years, Min=18 years, Max=78 years) completed the online survey.

Demographic characteristics		% (N)
Age (years)	18-30	44.0% (242)
	31-64	52.4% (289)
	65+	3.6% (20)
Sex	Male	50.5% (279)
	Female	49.3% (272)
	Other	0.2% (1)
Country of residence	Australia	40.9% (226)
	Spain	16.5% (91)
	Sweden	15.6% (86)
	Lebanon	19.4% (107)
	United States	3.6% (20)
	United Kingdom	1.3% (7)
	Other	2.7% (15)
Partner/spouse that regularly travels with you in a motor vehicle?	No	39.9% (220)
	Yes	60.1% (332)
Child(ren) that regularly travels with you in a motor vehicle?	No	70.3% (388)
	Yes	29.7% (164)
Older relative(s) that regularly travels with you in a motor vehicle?	No	78.8% (435)
	Yes	21.2% (117)

RESULTS

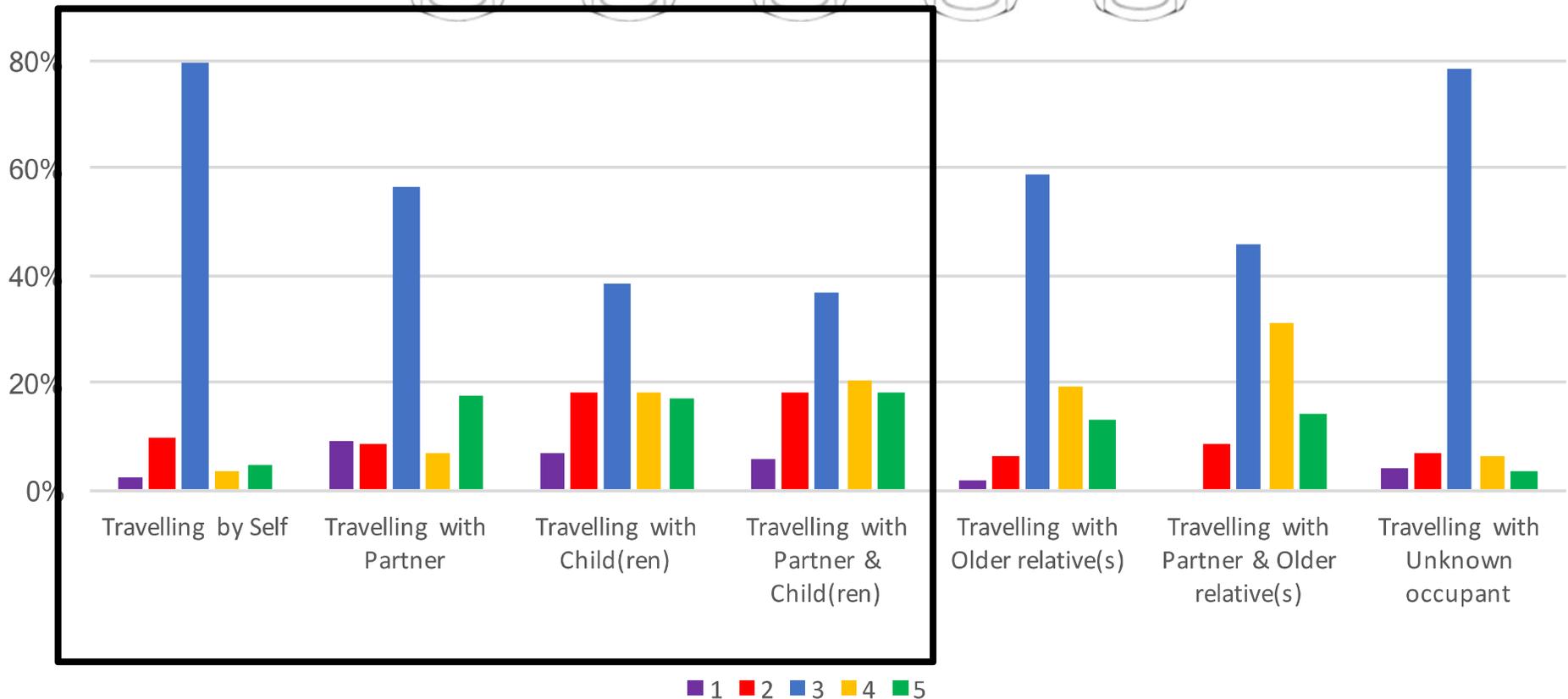
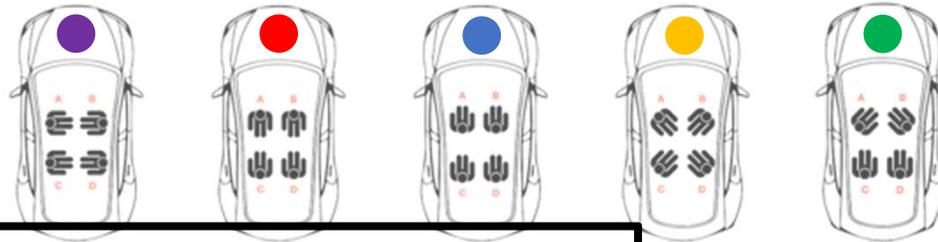
164 Ps (M=44.1 years, SD=9.2 years, Min=24 years, Max=71 years) completed the online survey:

- Provided details for n = 258 children with whom they regularly travel in a motor vehicle.

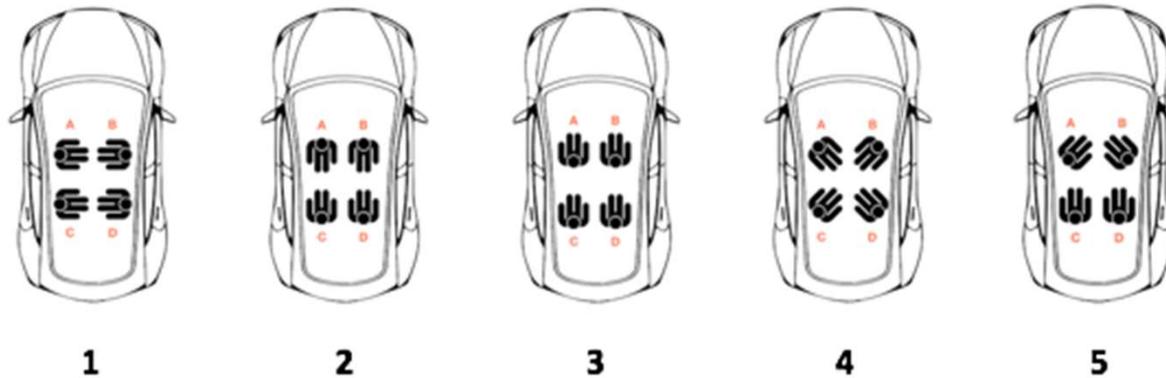
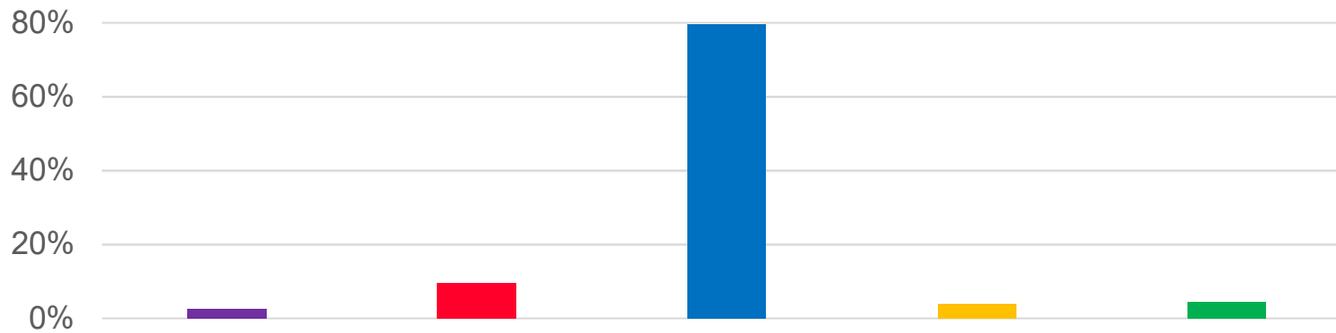
Demographic characteristics		% (N)
Age (years)	18-30	4.5% (7)
	31-64	91.7% (144)
	65+	3.8% (6)
Sex	Male	40.1% (63)
	Female	59.9% (94)
Country of residence	Australia	49.7% (78)
	Spain	5.1% (8)
	Sweden	24.8% (39)
	Lebanon	20.4% (32)
Child(ren) age (years)	0-1	4.7% (12)
	2-4	14.0% (36)
	5-7	19.8% (51)
	8+	61.6% (159)
Child(ren) sex	Male	48.7% (126)
	Female	51.3% (132)

RESULTS

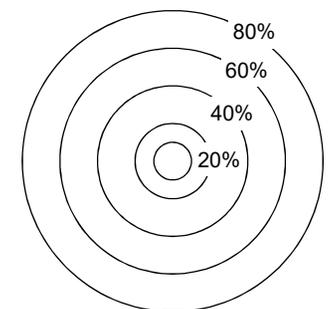
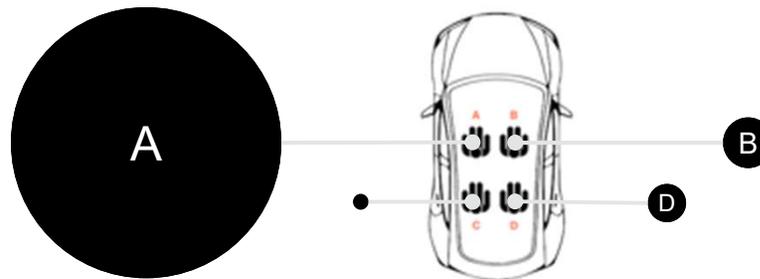
Ps asked to select 1 of 5 seating configurations across 7 hypothetical travelling scenarios:



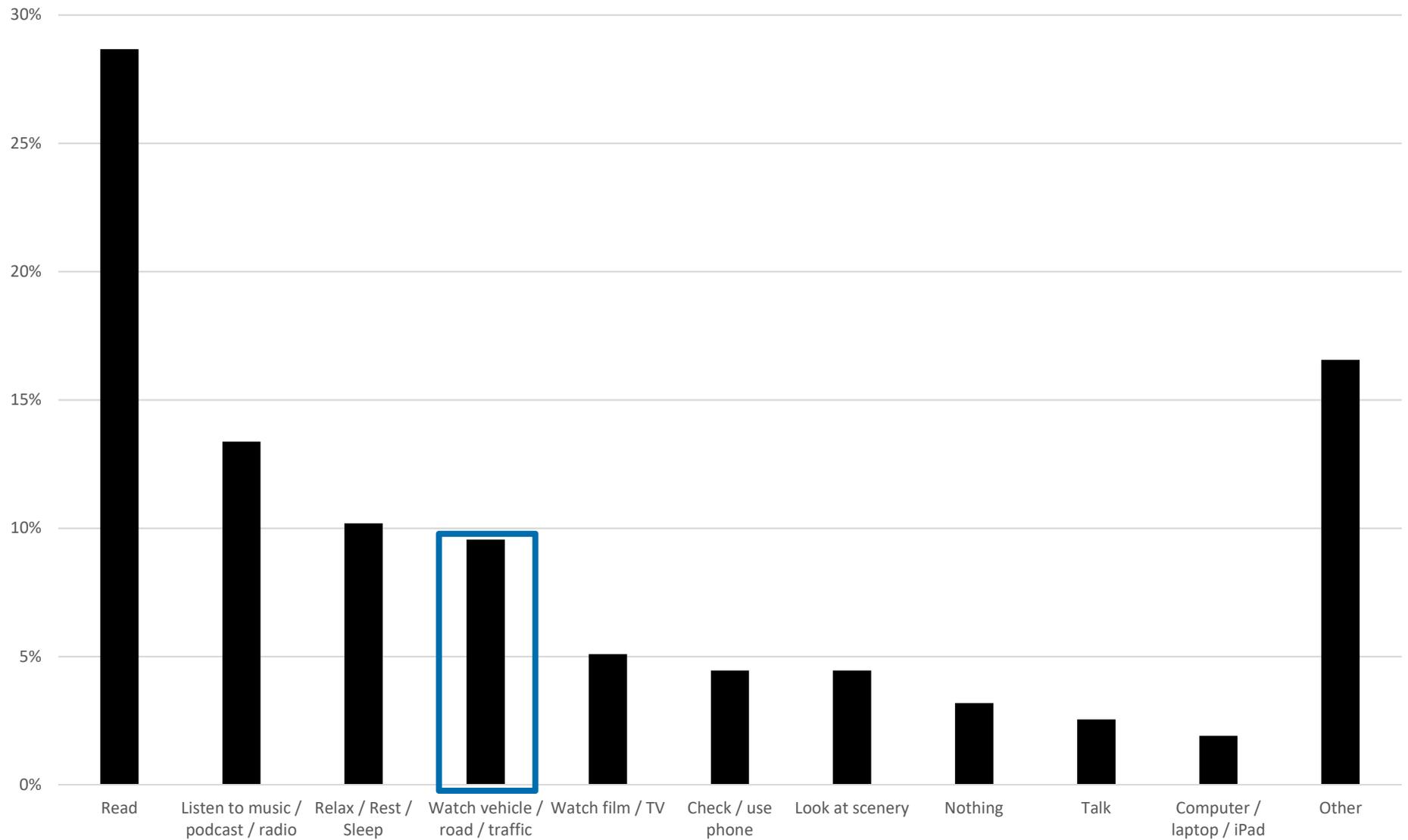
Self: Seat Config. & Position



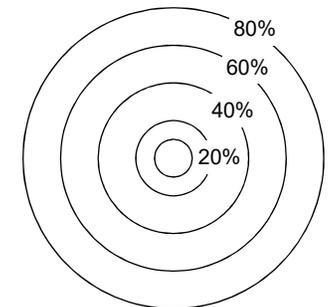
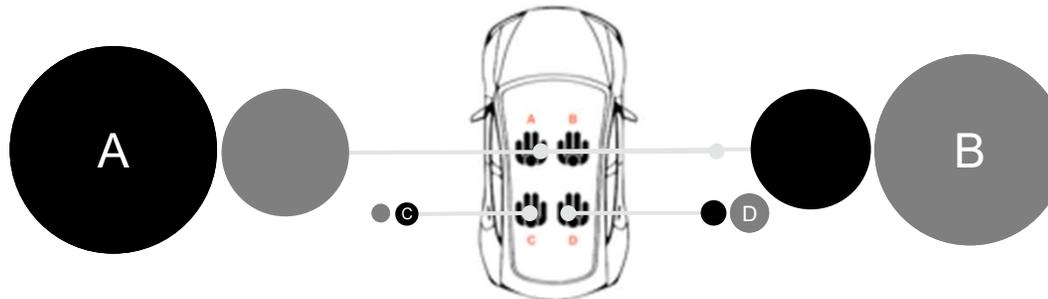
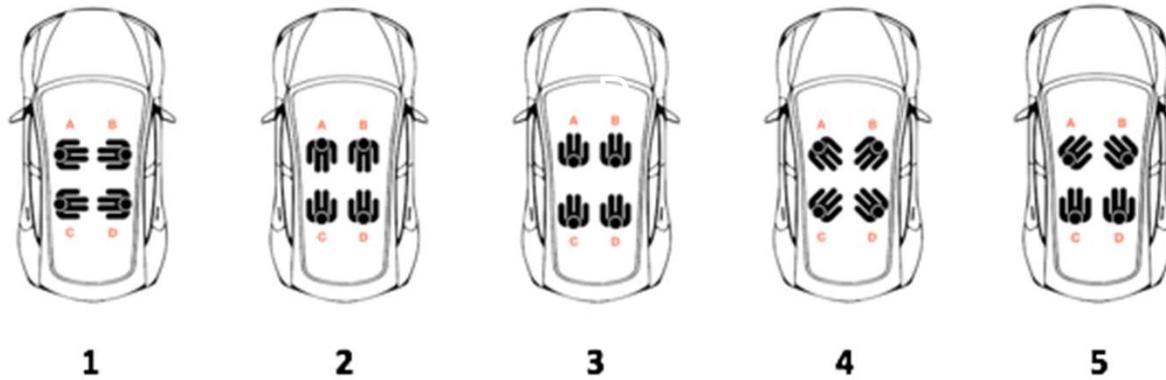
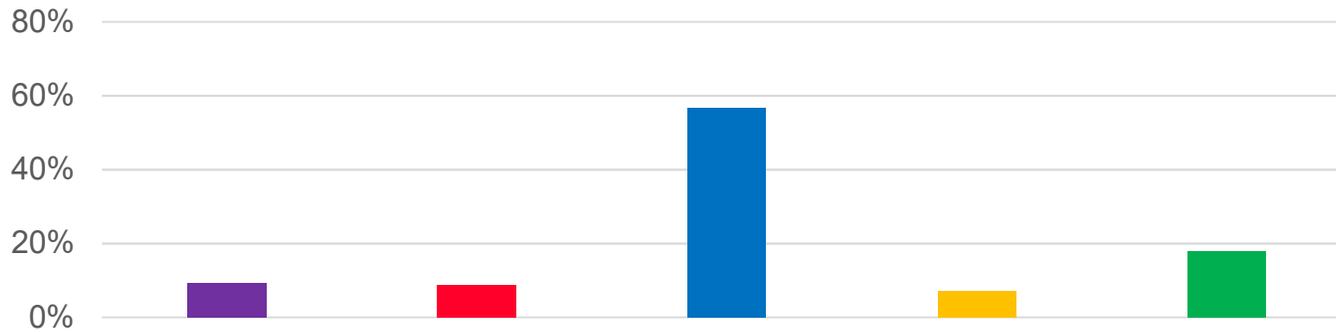
● Self



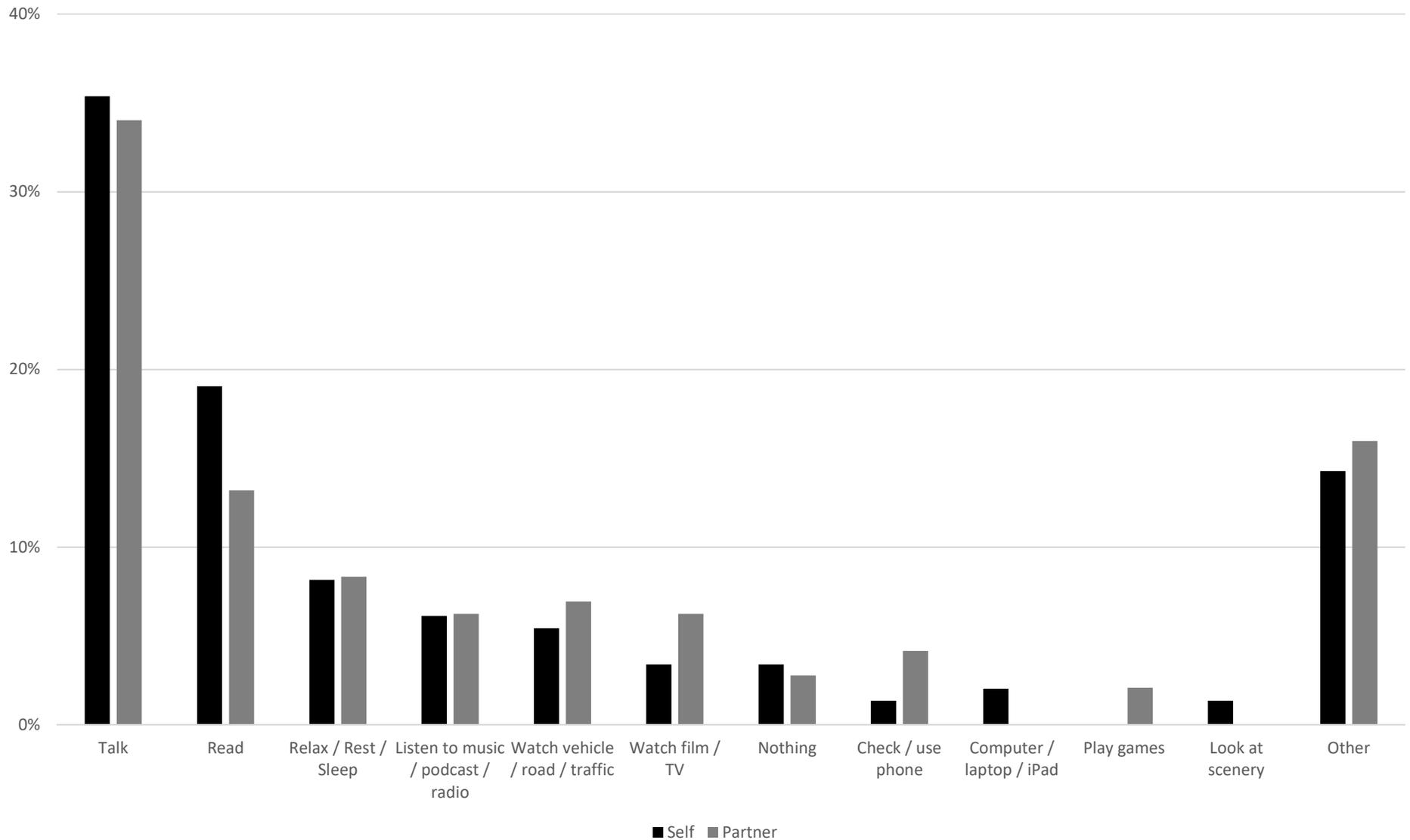
Self: Activities



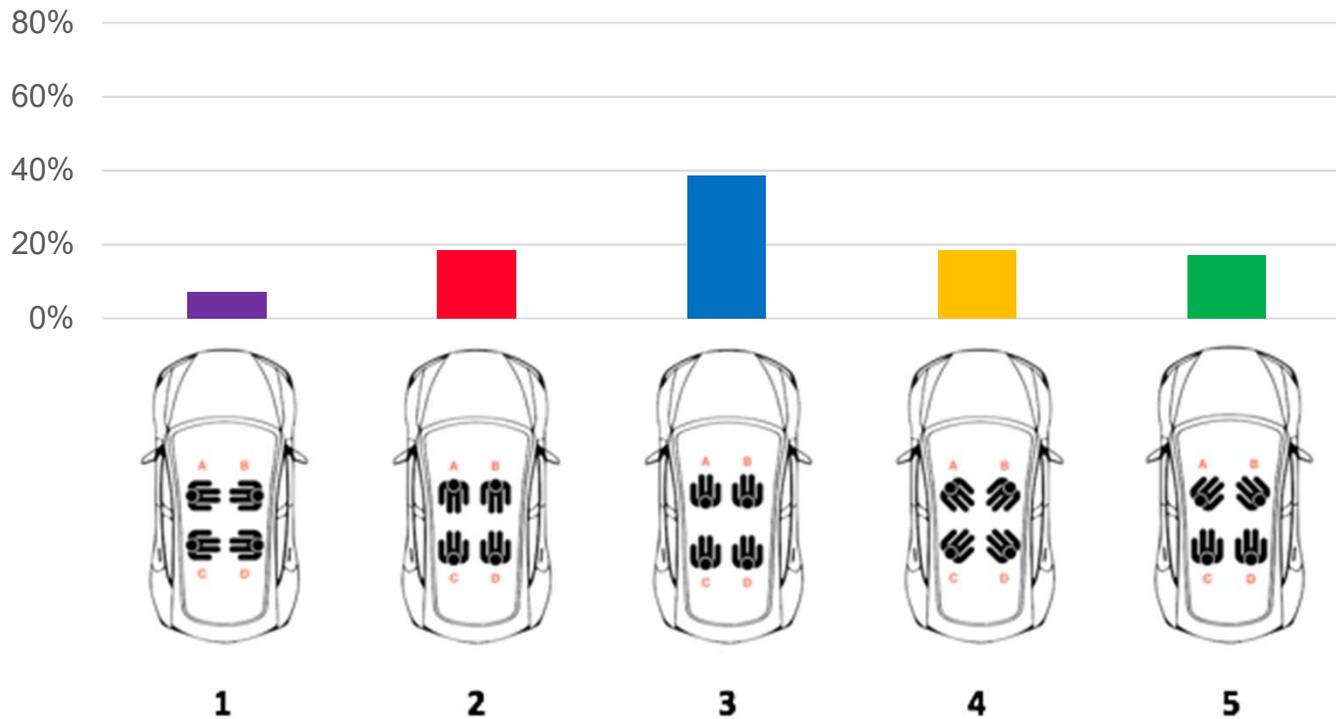
With Partner: Seat Config. & Position



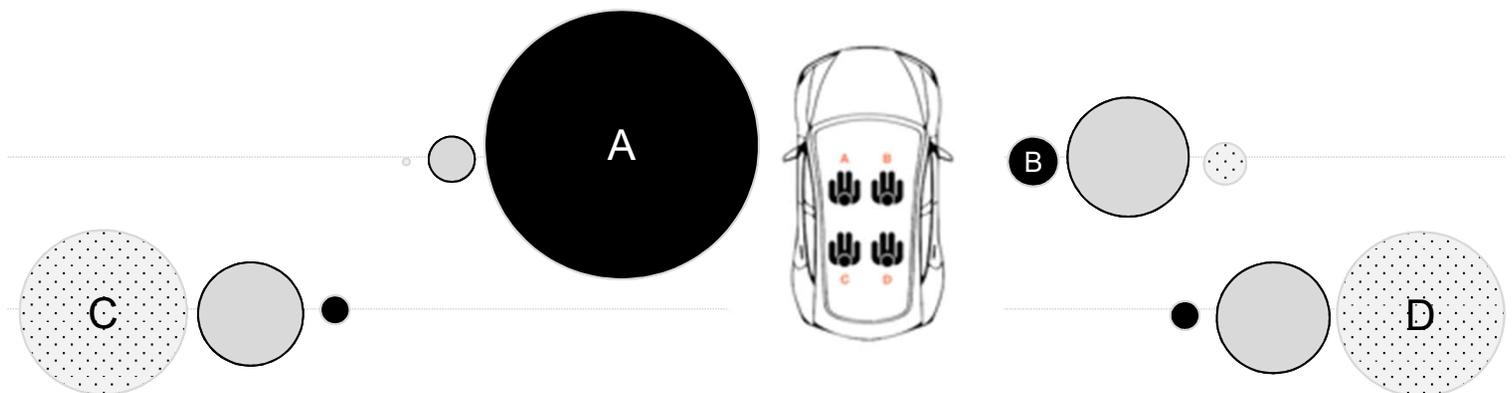
With Partner: Activities



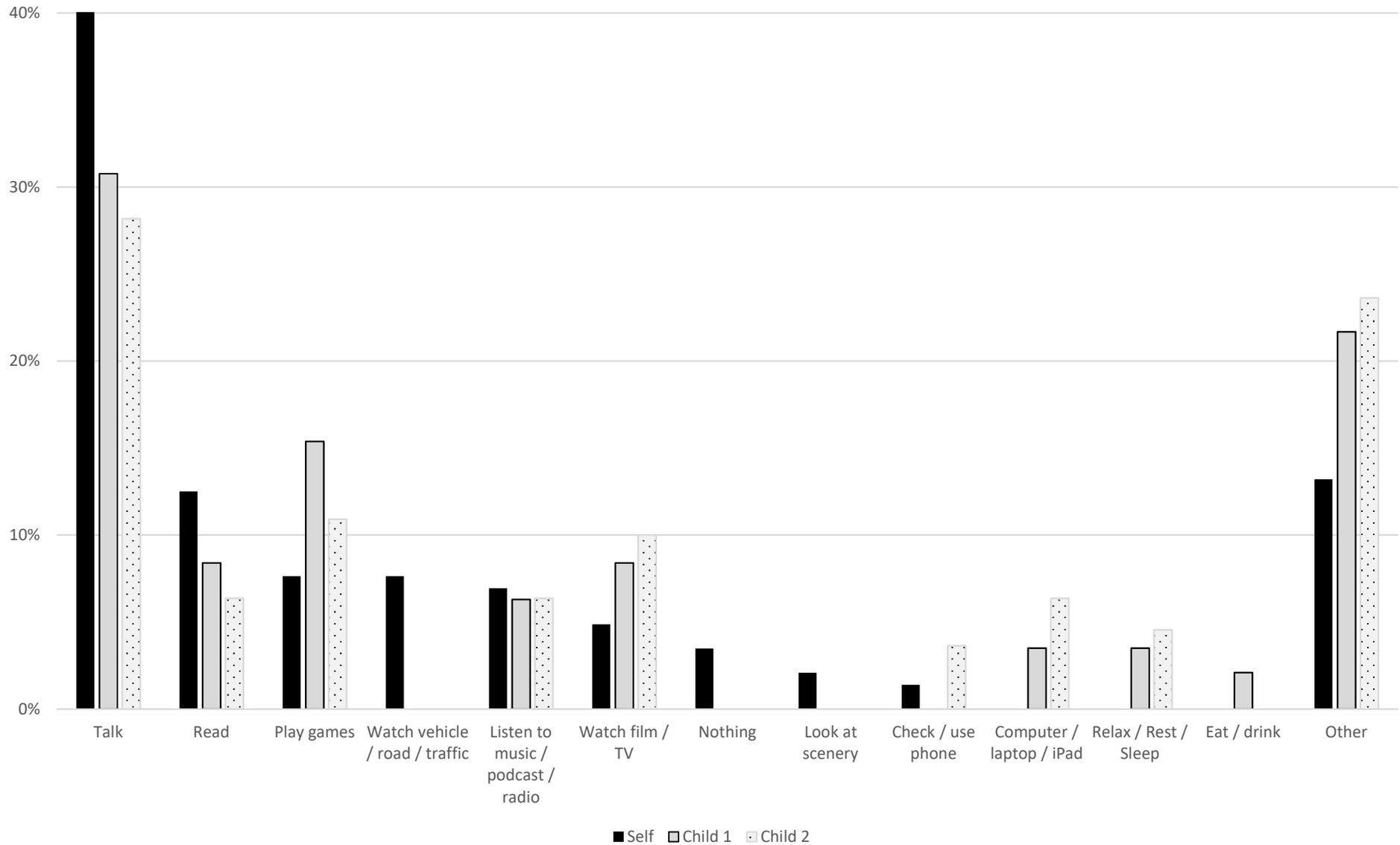
With Child(ren): Seat Config. & Position



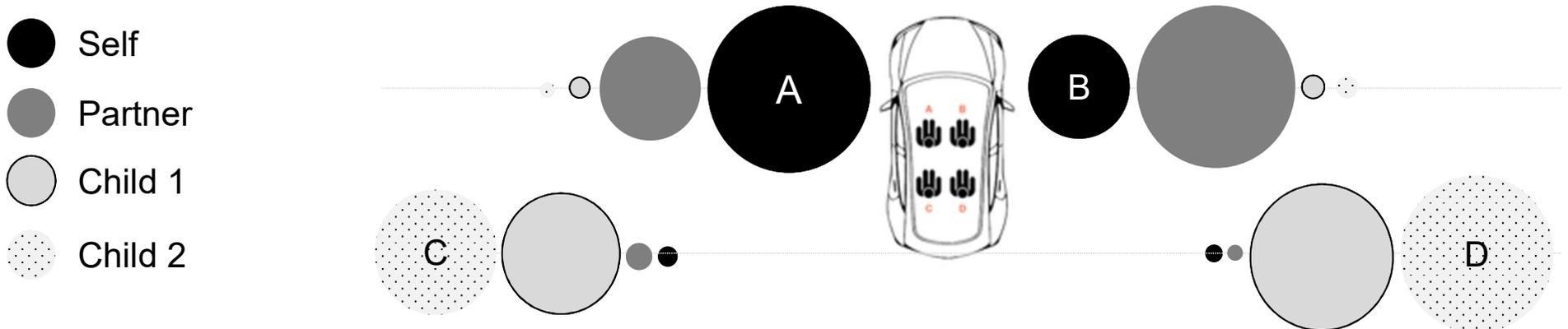
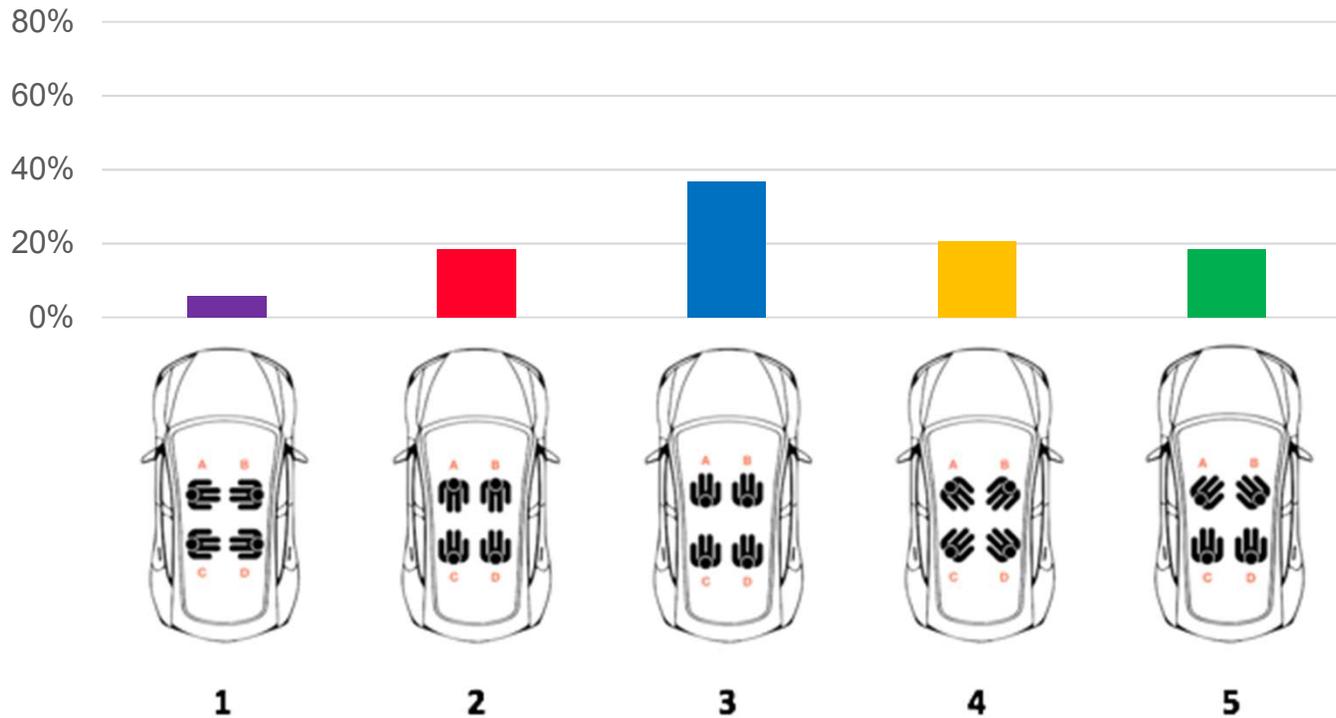
- Self
- Child 1
- ◐ Child 2



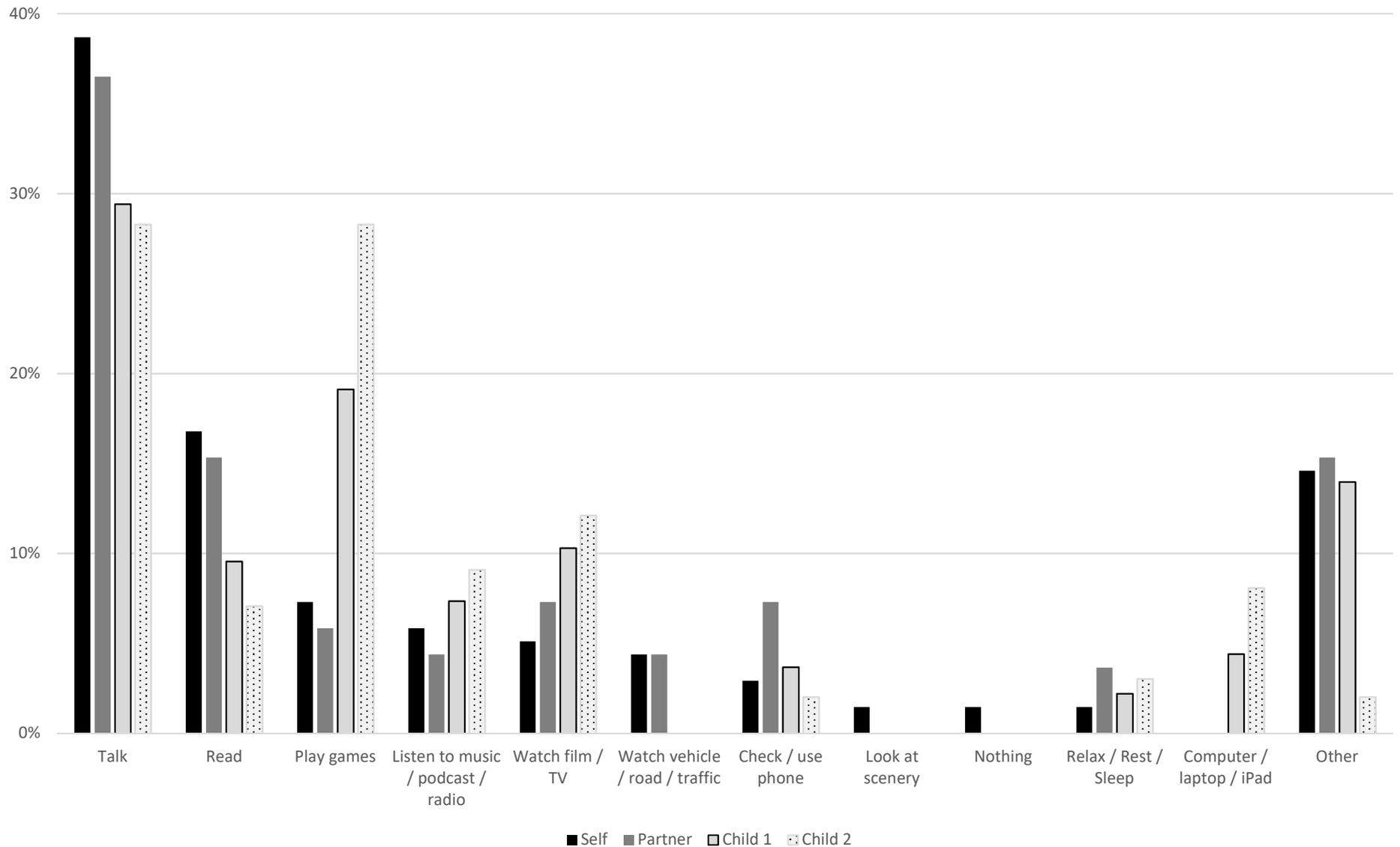
With Child(ren): Activities



With Partner & Child(ren): Seat Config. & Position

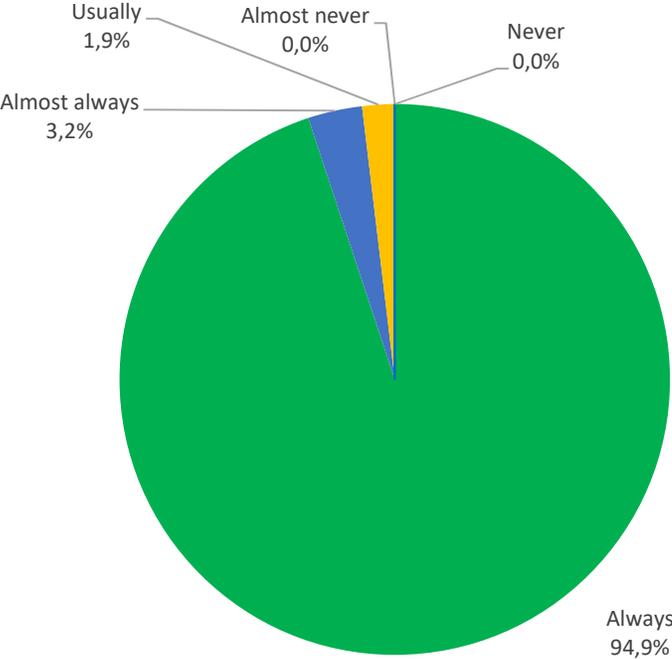


With Partner & Child(ren): Activities

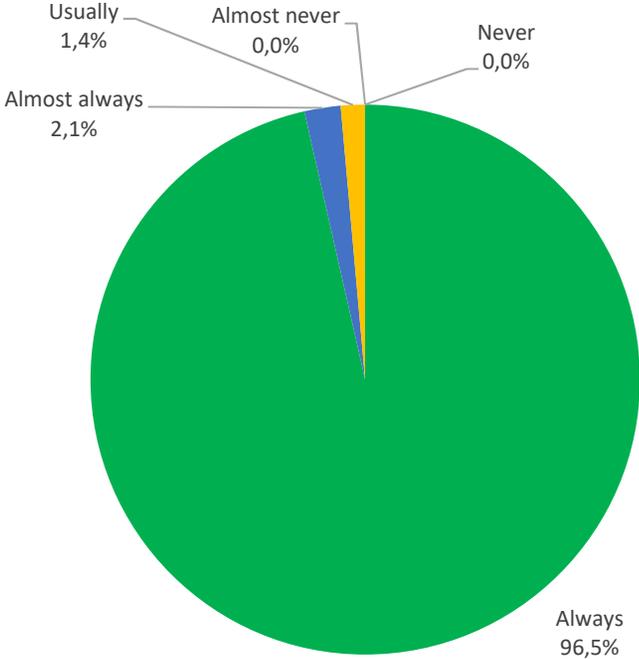


Seatbelt Use

Current seatbelt use?

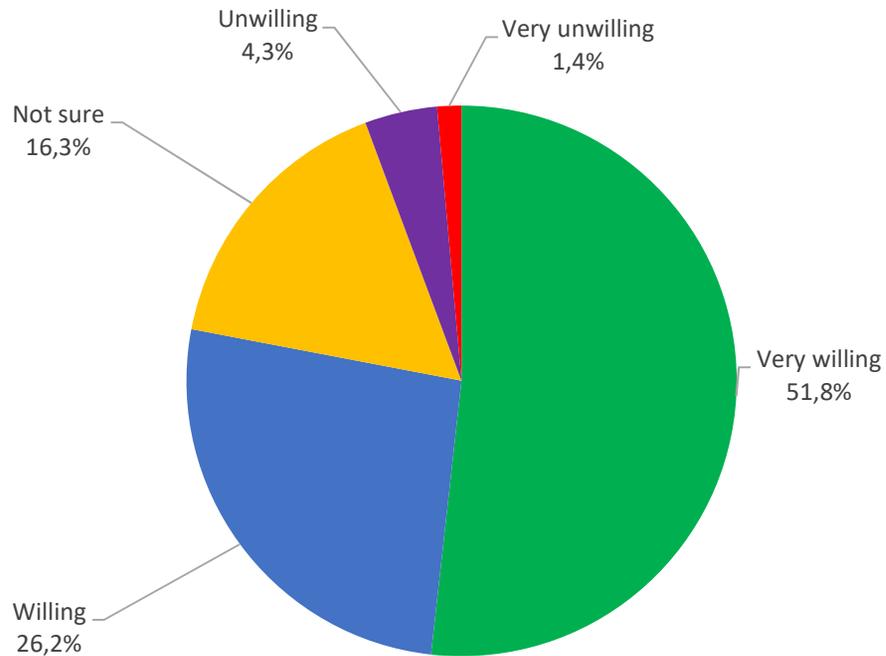


Predicted seatbelt use in FAV?

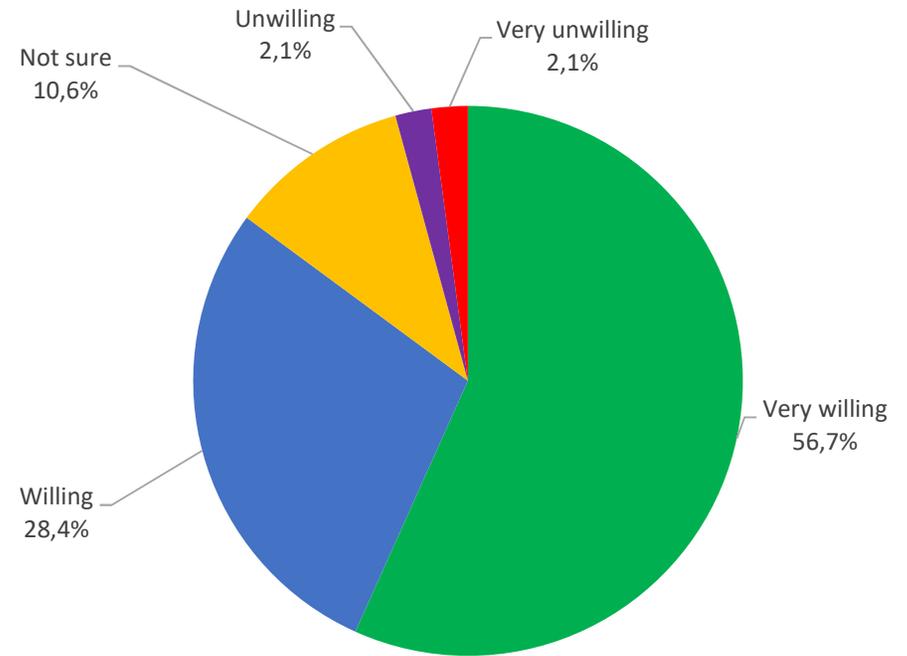


Willingness to wear different seatbelt in FAV?

Seated in non forward-facing mode?



While reclined?



DISCUSSION

Across all travelling scenarios, Ps most likely to prefer conventional, forward-facing seating configuration (i.e., #3).

- Most likely when travelling by themselves (79.6%) & least likely when travelling with child occupants (38.8%) or partner + child occupants (36.9%).
- Consistent with Jorlov et al. (2017) who reported that Ps' preferences depended on whether they were travelling with other occupants.

Across all travelling scenarios, Ps most likely to prefer seating position A (i.e., conventional driver's seating position), regardless of whether they were travelling with other occupants.

- Not aware of other literature that has investigated seating position preferences within FAV.

Ps predicted they would engage in wide variety of activities in while travelling in FAV – however depended on who they were travelling with:

- By themselves = Read (27.4%), Listen to music/podcast/radio (13.4%), Relax/Rest/Sleep (10.2%);
- With partner = Talk (35.4%), Read (19.0%), Relax/Rest/Sleep (8.2%);
- With child occupant(s) = Talk (29.6%), Read (7.5%), Play games (13.4%), &
- With partner + child occupants = Talk (38.7%), Read (16.8%), Play games (7.3%).

DISCUSSION

Ps' predicted seatbelt wearing rates were very high, with ~ 99% indicating that they would 'always' or 'almost always' wear their seatbelt when travelling in a FAV.

Most Ps also 'very willing' or 'willing' to using different seatbelt configurations when travelling in non-forward-facing modes (78.0%) or while reclined (85.1%).

- Consistent with Jorlov et al. (2017) = majority of Swedish Ps would be willing to accommodate additional or alternative seatbelt configurations.
- Consistent with Osvalder et al. (2015) = Swedish Ps' acceptance of different seatbelt configurations during real-world driving trip was high (81%), & acceptance increased during driving trip.
- Given willingness, introduction of new configurations may be able to be accommodated by vehicle designers without inconveniencing vehicle occupants.



DISCUSSION

Several limitations should be noted.

Findings based on Ps' predicted seating configuration & position preferences, & willingness to use different seatbelt configurations, without having experienced them in the real-world.

- Preferences may change when they experience seating configurations & positions dynamically (i.e., motion sickness, Sivek & Schoettle, 2015).

Survey did not collect data on child occupants' restraint type (i.e., RFCRS, FFCRS, BS, seatbelt).

- Future research explore restraint type on seating configuration & position preferences.

Due to low numbers, did not explore potential differences in seating configuration & position preferences across countries.

- Future research explore seating configuration & position preferences across countries – including consideration to differences in CRS legislation.

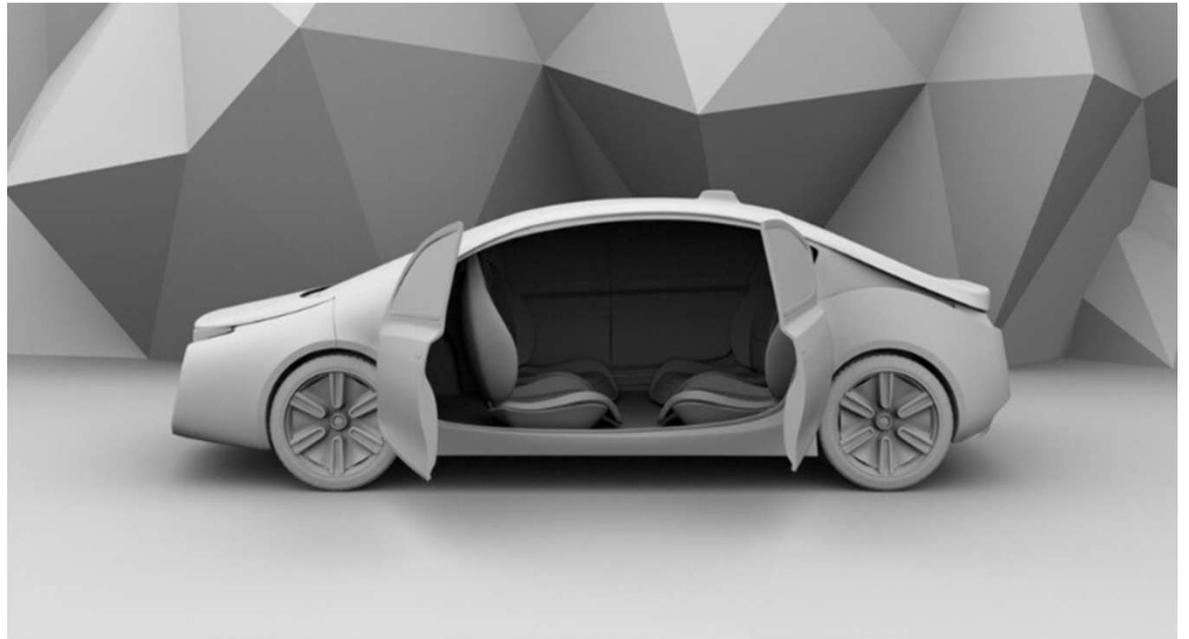
Findings based on convenience sample = may be result of 'volunteer bias' = individuals who participated may be more interested in FAV or road safety more generally.

- Future research should recruit larger sample (within each country) to ensure findings are applicable to general driving population.

CONCLUSION

Findings provided valuable insight regarding preferences for seating configurations, positions, activities & restraint use while travelling with child occupants in a FAV.

Future research will explore child occupants' restraint type (i.e., RFCRS, FFCRS, BS, seatbelt) & preferences for FAV travel, as well as the potential injury implications for these preferences in the event of a MVC.





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