

had fulfilled the established experience and performance design criteria. During the assessment process, the experience as well as performance based criteria were evaluated using a success or failure rating (see Figure 7).

Experience criteria	Required	Desirable (High)	Desirable (Moderate)	Desirable (Low)	Key: Criteria fulfilled Criteria not fulfilled
Repetition of higher order form elements			Refer to diagrams on the right.		
Repetition of lower order form elements			Refer to diagrams on the right.		
High-performance design elements should be styled to appear complex in composition and use minimal form element repetition			High-performance elements use a variety of trim and colour contrasts. Strong surface transitions are also used.		
Luxury design elements should be styled to appear simple in composition and use frequent form element repetition			Elements intended to express luxury were the forward dash, door shoulder line and seats. Their simplicity was visually expressed through the repetitive use of higher order form elements.		
High-performance design elements should reference contemporary F1 race cars			Refer to diagrams on the right. For further details, refer to 7.1 and 7.3.		
Interior design proposal expression should compliment the existing exterior aesthetic expression	Use of higher and lower order form elements identified in the exterior, a strong F1 theme and use of negative space gives this interior a similar expression to the exterior.				
Secondary control features should be easy to comprehend.			Use of commonly recognised ISO 2575 control icons (Figure 056).		

Figure 7. An example of the internal evaluation of experience criteria of the concept interior.

The external evaluation employed a qualitative-quantitative questionnaire. In total, nine respondents participated in the evaluation. The respondent group, consisting of sales representatives for six premium and high performance car brands (Audi, Bentley, Ferrari, Lamborghini, Mercedes Benz, and Porsche), was chosen to represent a valid consumer group in terms of sensitivity and knowledge of exotic cars.

The evaluation questionnaire employed three evaluation techniques in a total of five questions. Visual analogue scales (see, e.g. Küller 1975, Gould *et al.* 2002, Schütte 2005) were used for subjective rating of visual product experience with respect to the degree respondents perceived the interior design to express the three core values luxury, exoticness and high performance (questions 1-3). For question 4, a five point Likert scale (see, e.g., Osgood *et al.* 1957) was used to rate the degree to which the interior design was perceived to complement the exterior design. For each question, an open ended response opportunity provided respondents to qualitatively explain their response. The questionnaire concluded with an opportunity to provide general comments regarding the interior concept.

The evaluation procedure was initiated with an introduction and the presentation of visual imagery of the interior design proposal. Questionnaires were then given to the participants. Participants were invited to answer questions 1 - 3 in reference to imagery of the interior design proposal. After question 3, participants were shown imagery of the existing exterior. Participants were then invited to answer question 4.

Results

The results from the internal evaluation indicated that, in total, 47 out of the 49 established design criteria were successfully fulfilled. Of these, all experience criteria were fulfilled, while two of the performance criteria were not fulfilled by the design concept. Of the two considered unfulfilled, their exclusion can be summarised by the identification of unforeseen design issues making them inappropriate to achieve within the scope of the project.

The results from the external evaluation are illustrated in Figure 8. The mean VAS response for question 1 was 61%, indicating that the interior design proposal has a moderate level of perceived visual 'luxury'. Consequently, this result suggests that the interior design proposal successfully achieved its desired visual expression with regard to 'luxury'.

The mean VAS response for question 2 was 76%, suggesting that the interior design proposal had a high level of perceived visual 'high-performance'. This result validates earlier background research stating that the visual expression of the design proposal should have strong references to 'high-performance' but not be an actual 'high-performance' interior.

The mean VAS response for question 3 was 79%, indicating that the interior design proposal had a high level of perceived visual 'exoticness', suggesting the interior design proposal successfully achieved its desired visual expression in terms of 'exoticness'.

The mean response for question 4 was 4.6/5.0. This suggests that the interior design proposal is highly appropriate in relation to the existing exterior.

Discussion

The results from this study generated a range of insights. The PPE framework provided a highly effective structural approach to research, identify, map and define contemporary motorcar visual design motifs. These motifs proved to be an effective starting point for the discussion, generation and justification of experience based design criteria to support and direct the development of the concept motorcar interior. Furthermore, the identification of these motifs illustrated the effectiveness of the PPE framework as a tool for building a visual design format within a contemporary market context.

Evaluating the interior design proposal against performance design criteria was a straight forward task due to the quantifiable nature of the established performance criteria. Despite their subjective nature, evaluating the experience criteria proved similar in ease to the performance criteria. Much of this is attributed to the use of the PPE framework, where its strong analytical structure underpinned much of the experience criteria. For example, the framework denotes the analysis of aesthetic characteristics through higher and lower order form elements. Analysing the interior design proposal for these higher and lower form elements made it simple to discern whether it had a similar exterior form language characteristics to the existing exterior.

Question:	How do you think this interior rates in terms of 'luxury'																								
1A	<p>Not at all To a great extent</p> <p style="text-align: center;">$\bar{x} = 60.7\%$</p>																								
1B	<p>" Would like to see a greater level of 'plushness' "</p> <p>" Ultra contemporary "</p> <p>" Not luxury due to its hard edged look "</p>																								
Question:	How do you think this interior rates in terms of 'high-performance'																								
2A	<p>Not at all To a great extent</p> <p style="text-align: center;">$\bar{x} = 75.8\%$</p>																								
2B	<p>" Colours work well, seat design looks sporty "</p> <p>" Purposeful, non cluttered design. No frills. "</p>																								
Question:	How do you think this interior rates in terms of 'exoticness'																								
3A	<p>Not at all To a great extent</p> <p style="text-align: center;">$\bar{x} = 79.0\%$</p>																								
3B	<p>" Very unusual looking steering column "</p> <p>" Exotic interior ambiance "</p> <p>" Harness seat belts "</p> <p>" Steering wheel setup unusual "</p>																								
Question:	How well does the interior concept compliment the exterior design?																								
4A	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>Tick-box rating assessment</td> <td>High</td> <td></td> <td></td> <td></td> <td>Low</td> </tr> <tr> <td></td> <td>5</td> <td>4</td> <td>3</td> <td>2</td> <td>1</td> </tr> <tr> <td>Participant responses</td> <td>6</td> <td>2</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>Mean response</td> <td colspan="5">4.6 / 5.0</td> </tr> </table>	Tick-box rating assessment	High				Low		5	4	3	2	1	Participant responses	6	2	1	0	0	Mean response	4.6 / 5.0				
Tick-box rating assessment	High				Low																				
	5	4	3	2	1																				
Participant responses	6	2	1	0	0																				
Mean response	4.6 / 5.0																								
4B	<p>" ...interior is a cockpit as expected. "</p> <p>" ...compatible DNA "</p> <p>" Same design cues, colour and shape "</p>																								

Figure 8. Results from the external design evaluation.

The scope of this study did not allow for a statistically valid evaluation of the interior design proposal. Consequently, the results from this study were focused towards overall impressions of the design proposal. Due to the limitations of the questionnaire, there was no analytical means of discerning whether participant answers referred to formal aesthetic qualities, semantic qualities, or a combination of both, or what specific features they were referring to. The evaluation tools employed have been successfully used in previous PPE studies to evaluate participants' perception of products in relation to a range of PPE experience modes (see Warell 2008a, Wang 2008, Young 2008, Warell 2007, Warell *et al.* 2006). Although the sample group size for the questionnaire was limited, their expertise in the areas of luxury, high-performance and exoticness in context to motorcars indicate that the final design successfully embodied intended syntactic and semantic references, and provided intended experiences as perceived by users.

Conclusion

This paper illustrates how the PPE framework can be applied as an effective tool for establishing an appropriately and creatively managed design direction during the design development process. Providing a number of benefits for design research, the framework helps position, benchmark and develop visual design characteristics within a contemporary market context. The framework also supports the development of appropriate, valid and measurable experience design criteria, which traditionally is difficult due to the subjective nature of design perception.

The results from the external evaluation indicated that the PPE framework was useful as an effective tool for semantic and syntactic transfer; i.e. to convey intended expressions and achieve a pleasurable visual aesthetic, as perceived by external respondents representing the target consumer group. Expressions and appreciations of the concept motorcar interior as perceived by the expert respondent group were aligned with the intended PPE specifications as outlined by the experience design criteria.

Furthermore, this paper demonstrates that many of the theoretical aspects associated with the PPE framework can be transferred into design practice to elicit desired visual product expressions. The successful application of the PPE framework also illustrates its usefulness as a tool for integrating intended visual presentational and representational qualities such as appreciation, expression, and meaning within products in a validated way. The effectiveness of the framework and associated tools is illustrated in the way that criteria were established and used to direct ongoing design work, leading to an evaluated design outcome that was perceived and assessed according to desired key brand values and expressions. Implications for quality management and affective engineering includes the potential to use the framework as a tool to improve process quality in design management, and the use of the framework to support the design of Kansei Engineering studies, particularly with respect to identifying and categorising relevant experience aspects. This is of value for communicating, managing and direction design work on operational and strategic levels of design, and has the potential to contribute to quality assuring design processes.

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References

- Abbot, Marcus et al. 2006. Engineering emotional product identities in high-luxury vehicles. In P. M. A. Desmet, M. A. Karlsson, and J. van Erp (Eds.), *Design & Emotion 2006; Proceedings of The International Conference on Design and Emotion*, September 27-29. Gothenburg, Sweden: Chalmers University of Technology.
- Arnheim, Rudolf (1970). *Visual Thinking*. London: Faber and Faber Limited.
- Autocar (2005). *Media Gallery*. Retrieved 07/04/2006 from <http://www.supercarsnz.com/gallery.html>.
- Chandler, D. (1994). *Semiotics for Beginners*. URL <http://www.aber.ac.uk/media/Documents/S4B/> [2006-04-05].
- Crilly, Nathan; Moultrie, James and Clarkson, P. John (2004). Seeing things: consumer response to the visual domain in product design. *Design Studies*, Vol. 25, No. 6, November, pp. 547–577.
- Desmet, P. M. A. (2002). *Designing Emotions*. Technical University of Delft, Delft.
- Downton, P. (2003). *Design Research*. Melbourne: RMIT University Press.
- Givechi, R. and Velasquez, V. (2004). Positive Space. In: Mcdonaugh, D.; Hekkert, P.; van Erp, J.; and Gyi, D. (Eds.), *Design and Emotion: The Experience of Everyday Things*. Taylor and Francis, London, pp. 12-17.
- Gould, D. J., Kelly, D., Goldstone, L., and Gammon, L. (2002). Examining the validity of pressure ulcer risk assessment scales: developing and using illustrated patient simulations to collect the data. *Journal of Clinical Nursing*, 10, pp. 697-706.
- Jordan, Patrick (2000). *Designing Pleasurable Products*. London: Taylor & Francis.
- Karjalainen, Toni-Matti (2004). *Semantic Transformation in Design*. Helsinki: University of Art and Design.
- Karjalainen, Toni-Matti and Warell, Anders (2005). Do You Recognise This Tea Flask? Transformation of Brand Specific Product Identity through Visual Design Cues. In *Proceedings of International Design Congress – 2005idc, International Association of Societies of Design Research (IASDR)*, Nov. 1 – 4. Yunlin, Taiwan: National Yunlin University of Science and Technology.
- Krippendorff, Klaus (2006). *The Semantic Turn: A New Foundation for Design*. CRC Press: Taylor & Francis Group, Boca Raton.
- Küller, R. (1975). *Semantisk miljöbeskrivning (SMB)*. Stockholm: Psykologiförlaget

- Mano, Haim, and Oliver Richard L. (1993). Assessing the Dimensionality and Structure of the Consumption Experience: Evaluation, Feeling, and Satisfaction. *The Journal of Consumer Research*, 20(3):451-466 (December).
- Mather, George (2006). *Foundations of Perception*. Hove: Psychology Press Ltd.
- Monö, Rune (1997). *Design for Product Understanding*. Stockholm: Liber.
- Muller, Wim (2001). *Order and Meaning in Design*. Lemma Publishers, Utrecht.
- Norman, Donald (2004). *Emotional Design: Why we love (or hate) everyday things*. Basic Books.
- Osgood, C. E., Suci, G. J., and Tannenbaum, P. H. (1957). *The measurement of meaning*. Urbana: University of Illinois Press.
- Reisberg, Daniel (1996). *Cognition: Exploring the Science of the Mind*. W. W. New York: Norton & Company, Inc.
- Schütte, Simon (2005). *Engineering emotional values in product design – Kansei engineering in development*. Linköping: Linköping University.
- Seva, Rosemary R.; Duh, Henry Been-Lirn; and Helander, Martin G. (2007). The marketing implications of affective product design. *Applied Ergonomics* 38:723-731.
- Simon, H. A. (1992). Alternative representations for cognition: Search and Reasoning. In H. L. Pick, Jr., P. van den Broek, & D. C. Knill (Eds.), *Cognition: Conceptual and methodological issues* (pp. 121-142). Washington, DC: American Psychological Association.
- Solso, Robert L. (1999). *Cognition and the Visual Arts*. Cambridge: MIT Press.
- Tversky, A. and Kahnemann, D. (1981). The framing of decisions and the psychology of choice. *Science*, 211, 453-458.
- Vihma, Susann (1995). *Products as Representations: A Semiotic and Aesthetic Study of Design Products*. University of Art and Design, Helsinki.
- Visser, Willemien (2006). *The cognitive Artifacts of Designing*. Lawrence Erlbaum Associates, Publishers, London
- Wang, Diana (2008). *What do you think about this car? Perception and meaning of automotive design in New Zealand and Taiwan*. Wellington: Massey University.
- Warell, A. (2005). Visual Form Commonality. Nordcode 5th international seminar, Norwegian University of Science and Technology (NTNU), Trondheim, May 18-20.
- Warell, A. (2006). Identity Recognition in Product Design: An Approach for Design Management. *Proceedings of the 13th International Product Development Management Conference*. Milan, Italy: Politecnico di Milano, June 11-13.
- Warell, A. (2008a). Multi-modal visual experience of brand specific automobile design. *The TQM Journal*, Emerald Group Publishing Limited, August (forthcoming)
- Warell, A. V. (2007). Visual experience of brand-specific automobile design: Studying appreciation, emotion and comprehension using the VPE framework. *Proceedings of The First European Conference on Affective Design and Kansei (Emotion) Engineering*, Lund

University, June 18-20.

Warell, A., Fjellner C., Stridsman-Dahlström J. (2006). Visual Product Identity: Understanding identity perceptions conveyed by visual product design. *Proceedings of the 5th International Conference on Design & Emotion*. Chalmers University of Technology, Gothenburg, Sweden, September 27-29.

Warell, Anders (2001). Design Syntactics – A Functional Approach to Visual Product Form. Theory, Models, and Methods. Chalmers University of Technology, Gothenburg.

Warell, Anders (2008b). Modelling Perceptual Product Experience – Towards a Cohesive Framework of Presentation and Representation in Design. In *Design & Emotion 2008; Proceedings of the 6th International Conference on Design & Emotion*, October 6-9. Hong Kong: Hong Kong Polytechnic University (forthcoming).

Young, Kenneth (2008). *Interior Design proposal for the Hulme F1 Supercar*. Wellington: Massey University College of Creative Arts.